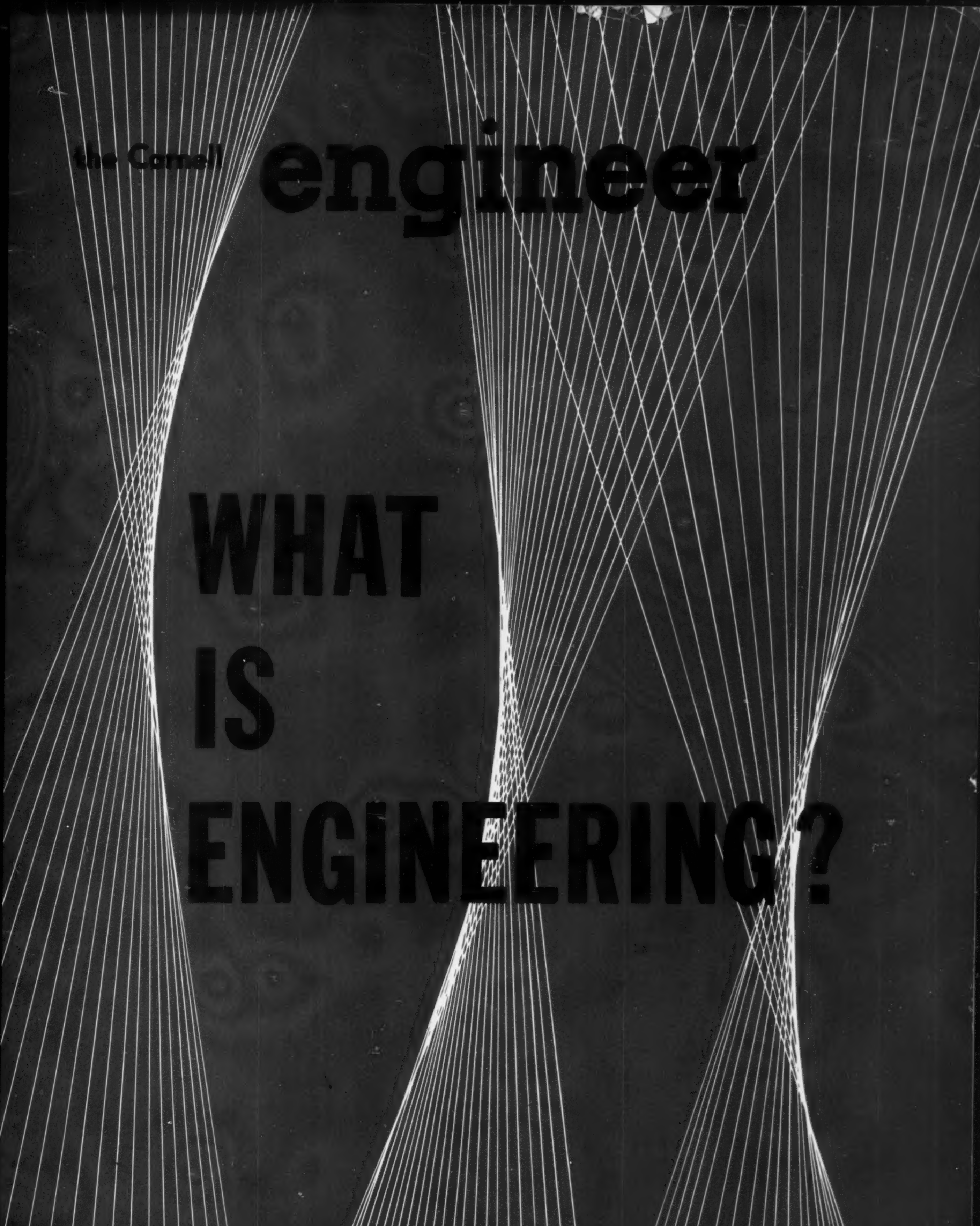

the Cornell

engineer

WHAT IS ENGINEERING?

COLLEGE OF ENGINEERING

NOVEMBER, 1959 VOL. 25, NO. 2

CORNELL UNIVERSITY

25 CENTS


R. Boyle

DOW is tomorrow-minded **people** . . .

A chemist, with his mind on his own specialty exclusively, might say: "The chief raw materials for Dow products are sea water, brine, petroleum, coal, oyster shells." Up to a point he would be right. But in fact he would be overlooking the most important ingredient of all—people of a certain exceptional kind and quality of mind.

Let's look at a quick profile of the kind of person Dow looks for. His mind and ambitions are not limited by the dimensions of the job he is doing. His horizons take in tomorrow, while he does his job well today. Problems appear to him in a dynamic context of both today *and* tomorrow. The "big picture" is not just a cynical phrase to him.

This broader view makes him plan well—for his family as well as for his job. As the phrase goes, he is "a good provider." He owns his own car. Chances are he owns his own home. Along with some 80,000 others he has invested in Dow stock because he believes in his company and wants to back up that belief with cash.

He is a builder at work or in his community. He gets a kick out of creating new things. Such products as Saran Wrap*, Separan* for the mining industry, the new fiber Zefran*, and others. Making things that do some important job for the human community, better than it has ever been done before, gives him a real thrill.

Not everyone who works for Dow, whether at Midland or the other 23 United States locations (plus 23 foreign and 5 Canadian), fits this profile. But by and large most of those who do well tend to. Though they have more than their share of "creative discontent," they have found a good place to grow, and work out their hopes, plans and ambitions.

If you would like to know more about the Dow opportunity, please write: Director of College Relations, Department 2427FW, THE DOW CHEMICAL COMPANY, Midland, Michigan.

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the Cornell engineer

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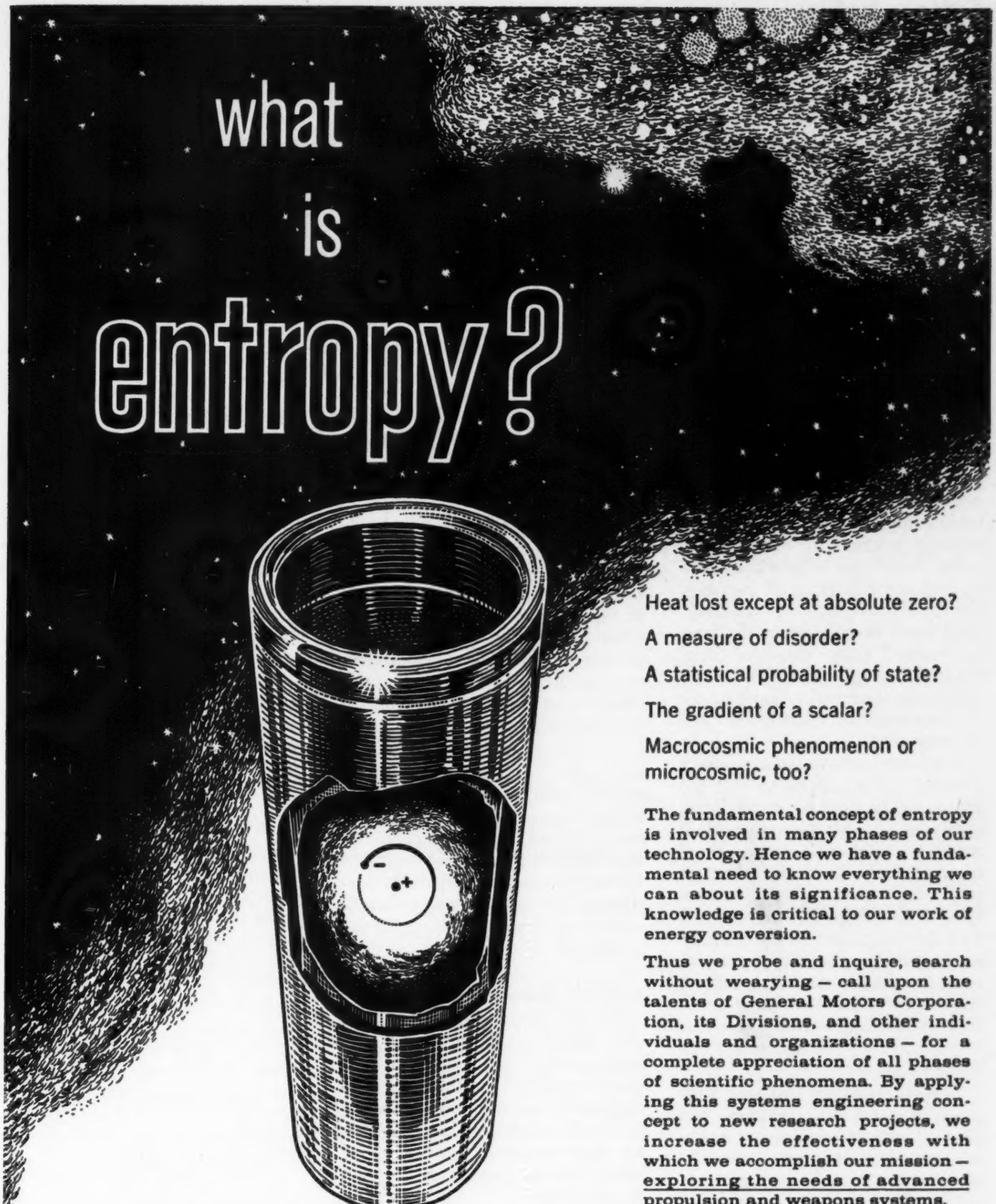
what
is
entropy?

Editorial . . .

TODAY'S CURRICULUM . . .
TOMORROW'S ENGINEER

Today's engineers are dealing with technical problems that were undreamed of five years ago. Modern requirements have put an enormous strain on the talents of every engineer and have necessitated extensive revisions in college training programs.

At Cornell we have witnessed a magnificent expansion of facilities. Four new engineering buildings have been completed in the past five years. Through the foresight of the buildings' planners, these structures were designed to meet future requirements of instruction and research.

Laboratories have been carefully planned and equipped so that the space may be used for many different types of work. Grumman Hall, new home of the Graduate School of Aeronautical Engineering, is particularly outstanding in this respect. The only piece of equipment that the designers feel will require no modification for many years to come is a high pressure air supply. Almost all of the remaining apparatus is planned so that alterations necessitated by the space age can easily be made.

Cornell engineers can look with pride at their new facilities, but the buildings and equipment would be valueless without carefully planned curricula. Today's problem of forming adequate courses of study in engineering is probably one of the most difficult educators have ever had to face.

Schools Review Curricula

It is gratifying to note that each of Cornell's engineering schools has a faculty committee carefully considering curriculum improvements. The fruits of their labors are readily apparent. The most cursory glance at the latest engineering catalog shows that some courses of study are almost unrecognizable when compared to those of a few years ago.

The one revision that appears most consistently throughout the College is the introduction of more electives. With the single exception of agricultural engineering, every other engineering program shows an increase in the number of electives or gives the student a wider selection of non-technical courses from which to choose.

We think this overall trend is a good one. Although there is a marked tendency for these electives to bunch up in the fifth year, we are confident that an increase in their number is wise and hope that further planning will make it possible to distribute the non-technical courses more evenly throughout the programs.

Technical Course Revision

A study of the technical courses now offered makes it immediately apparent that they have been subjected to careful scrutiny. We have observed a marked concern among professors about continually updating their material. In many cases, entire courses have been dropped or reorganized.

Much work is evident in the planning of the civil engineering program. The recent introduction of an electrical engineering sequence into that curriculum is only one of the many signs of studies being carried on in that school.

Wide revisions are evident too in the School of Chemical and Metallurgical Engineering and the Sibley School of Mechanical Engineering. The department of engineering physics initially planned its curriculum for maximum flexibility. This department has recently added a nuclear option available to the entire college. The completion of the reactor facility will undoubtedly give the option greater impetus.

The School of Electrical Engineering has made important revisions in their basic courses, but their most drastic re-examination is at the fifth year level where the senior project has been made optional. This innovation is, we feel, part of a needed college-wide review of the entire philosophy of Cornell's fifth year.

Other Groups Contribute

In all of this work in course evaluation, we, as students, can play an important role. We have always found the faculty anxious to hear student criticisms of the curriculum. *Eta Kappa Nu,* the electrical engineering honorary, has done some outstanding work in this matter of course appraisal. Here is an excellent opportunity for the honoraries in each school as well as *Tau Beta Pi* to do a real service to the College. The Cornell Student Engineering Council could also be helpful in this work.

Another group that is studying the curriculum is the Faculty Policy Committee. This committee is considering a number of improvements, several of which have been suggested by Dean Corson. With the work of these groups and the continued interest of students, faculty, and administration, the Cornell College of Engineering will continue to be one of the greatest in the world.—A.S.R.

Founded in 1885

THE CORNELL

engineer

NOVEMBER 1959 VOLUME 25 NO. 2

Every engineer has at some time in his career asked the question, "What is Engineering?" At Cornell the question is frequently asked by undergraduate engineers as well as by sub-frosh. In this issue of the CORNELL ENGINEER, *our authors have considered several aspects of this question. With their ideas in mind, we hope that you will be better able to arrive at your own answer.*

Cover Design by Richard Reif, Arch '61

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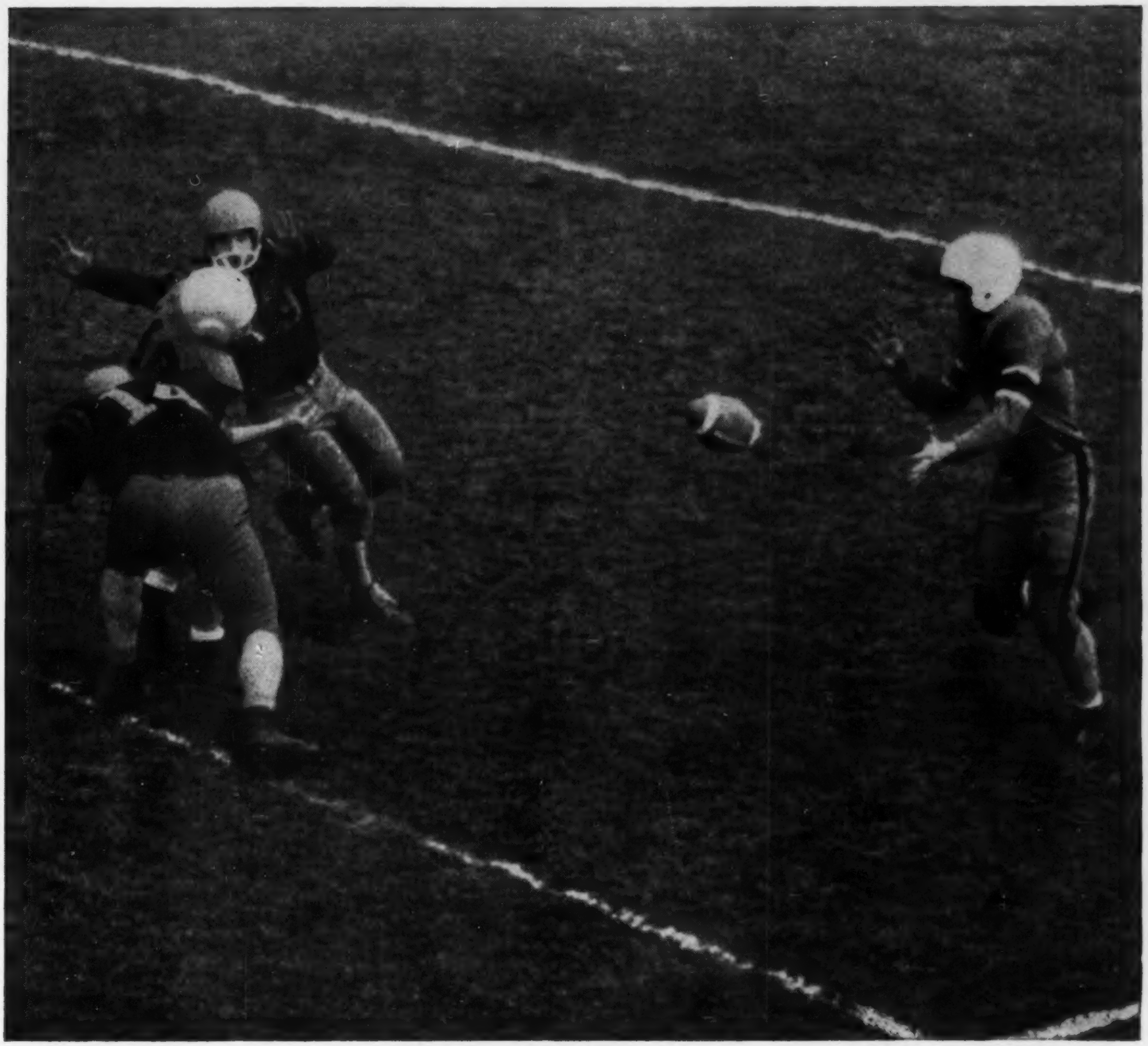

Thinking far up the road
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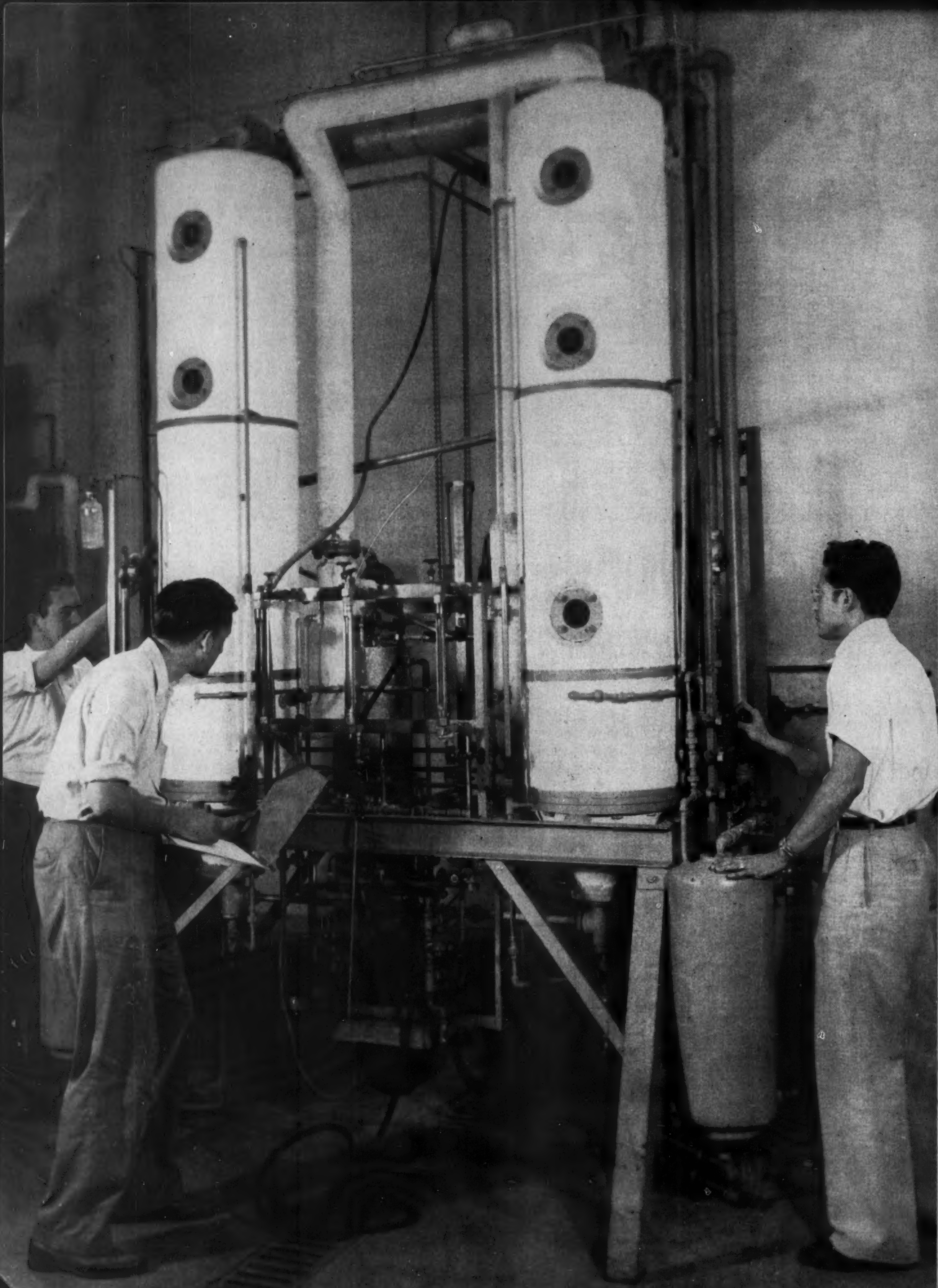

WHAT IS ENGINEERING SCHOOL LIKE?

Engineering education gives the student rigorous training in analytical thinking. Although the work is difficult, its rewards are many and its value indisputable.

by Donald H. Moyer

If you like mathematics and do well at it, and enjoy what science courses you may have had, somebody has probably suggested that you study engineering. This may have prompted you to find out what engineering is and what engineers do and you may have sent for some engineering school catalogs or may even already be enrolled in an engineering school. Assuming you have made your decision to have a stab at engineering, my purpose will be to try to give you some better idea than you may now have of what engineering schools are like and especially of how enrolling in one differs from just "going to college."

One of the first points to realize is that despite all the psychological tests of interests and abilities, there is so far no sure way for a young person in his teens to determine that he should be an engineer. Consequently, engineering schools are filled each fall with hundreds of students who despite all protestations have really made this decision on a tentative basis only. Students elect to undertake professional training not only without any firm conviction but also without understanding what the training program involves, and these blind spots can create real problems.

In telling you what engineering schools are like, I shall draw some comparisons with the liberal arts colleges. It will not be my purpose to demonstrate that either is superior to the other; the two have essentially different aims and the value of each must be appraised in the light of its own objectives. Thus, at the outset let us acknowledge that every individual who would enter professional employment must have the appropriate specialized training, but in addition it is equally important that an educated man learn of his heritage and the world around him through a study of what we have come to call the liberal arts, embracing as they do the natural and physical sciences, the social sciences, and the humanities. Education must be a blend of the general and the particular, the vocational and the universal; engineering and liberal arts education are not antithetical, but complementary. A proper disciplining of the mind is possible in either type of education, and either can serve as the first step beyond secondary school toward preparing one to become an educated man. On the other hand, neither general nor professional training can be neglected in the total pattern of one's education.

←

Engineering laboratory work gives you comprehensive training in experimental techniques as well as a first hand opportunity to apply basic principles. These chemical engineering students are operating a double effect evaporator.

Professional Training

An engineering college or technological institute is a professional school whose essential purpose is not a general liberal arts education but training for a highly developed professional career as for medicine or the law. But, compared with these other professions there is one big difference: the engineer begins his professional education directly upon graduation from high school while the doctor and the lawyer begin their strictly professional preparation only after they have been educated in the liberal arts and have entered graduate school.

Preparation for law and medicine is made in two schools and at two levels in higher education; in preparing for engineering there is for most students only one highly concentrated curriculum compressed into four or five years of intensive undergraduate study in one school. The prospective doctor or lawyer can weigh the prospects of professional training throughout his undergraduate college years and by the time he enters graduate school be more certain of his professional objective; the prospective engineer is asked to make his decision on professional training before he ever goes to college.

Engineering Curriculum

What is the engineering curriculum? To be sure, there are many programs each differing in some respect from others, but the basic constituents bear a strong similarity. Four principal categories of subject matter characterize the average engineering program: basic science and mathematics; applied engineering science; applied technology; and general, managerial, or liberal studies.

The first three of these categories are usually pursued in sequence with some overlapping; the last

category of nonscientific, nontechnical courses may be spread throughout the entire curriculum, but usually with a heavier concentration in the later years. Basic and applied engineering science are likely to occupy the first half or more of the whole program with applied technology deferred to the later years. Studies in the liberal arts, exclusive of science and mathematics, will seldom be found to account for more than 20 per cent of an engineering curriculum, if that much.

As an engineering student you should realize at the outset that despite all the whoop-te-do about the liberal arts content of engineering curricula, none are able to offer in one neat package of four or five years both a sound professional technological training on the one hand and on the other a thorough liberal arts education. Nor will the proportions be at all even; the prime purpose of the engineering school is scientific and technical and the programs will reflect this weighting even at the expense of slighting the liberal arts.

Ideally a budding engineer might profitably spend four years in a liberal arts college and upon receipt of a bachelor of arts degree embark upon three years or more of engineering education in much the same manner embryo medical doctors and lawyers do today, but the costs are considerable and the training of engineers has evolved in a different pattern. It is also true that today's average engineer cannot look forward, as can the physician, to the same high earnings in middle life with which to pay back the high expenses of his education.

One finds would-be engineers often seeking in engineering schools a balance of liberal and professional studies which actually does not exist. True, as much as 40 per cent or more of an engineering curriculum may consist of courses normally offered by liberal arts colleges, but inspection will reveal that over half of this proportion is made up of courses in science and mathematics. Thus, if you are going to engineering school, be prepared to forego the extensive opportunities to explore the humanities and social sciences which will be available to your friends in liberal arts colleges. You will have some opportunity to investigate these lines of interest, but for the most part it will be in the later years of your course. This leads to the question of electives and the flexibility of your program in an engineering school.

Program Flexibility

In a liberal arts college most of your courses are of your own choosing; in engineering school most of your courses are prescribed, and not only required of you but arranged in sequences which make your whole program of studies relatively inflexible. These are characteristics of any professional program and in this respect studying engineering differs markedly from attending a liberal arts college.

The restrictive influence of the curriculum imposes a discipline upon engineering students shared by few of their brothers in liberal arts. This can be especially trying to the freshman engineer, eager like all other young men to explore in many directions among the vast offerings of the college catalog, but bound to his daily regimen of math., physics, chemistry, English, and drawing, and, just perhaps, a liberal elective. Or, picture yourself a junior intent upon a particular course in the humanities as an allowed elective, but which simply comes at the wrong hour to be fitted into your schedule of required engineering courses.

These frustrations are not uncomman for engineering students. Be prepared, though, for another impact of a relatively rigid professional program of studies; the imposition of many prescribed courses precludes the possibility of dodging the hard ones. In a liberal arts college, if you find a subject hard or uninteresting, you can usually drop it after a term and move to other fields; in engineering you must meet it head on, period. These differences between engineering and liberal arts curricula will be revealed to you if you study the catalogs carefully. The important thing for you is to realize that they *are* different and not to expect from one what only the other can rightfully give.

Photo Science

Although course schedules for engineers often indicate a large number of liberal arts courses, many of these will be in science and related fields. There is room in your program for courses like this one in government, but careful planning is necessary to be sure that it can be included in your full schedule.

About the Author

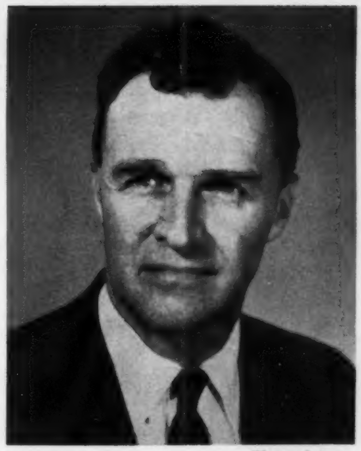

Photo Science

Donald H. Moyer is the Director of the Office of Student Personnel in the College of Engineering. His office works with matters concerning admissions, placement, alumni records, and the administration of engineering scholarships.

Mr. Moyer has been at Cornell since 1941 when he was a Counselor of Students. However in 1943 he left to serve as a Lieutenant Commander in the Naval Reserve. When he returned to Cornell in 1946 he was Assistant Director and later Director of Veterans' Education. He came to the College of Engineering in 1950.

In 1927 Mr. Moyer received his B.S. from Harvard College, and he won his M.A. in psychology from the University of Michigan one year later. Before coming to Cornell he served as a placement Officer at the University of Michigan and at Harvard College.

Ask any undergraduate on a university campus what group of students works the hardest, and he will probably tell you it's the engineers. Most students who come to engineering schools have heard this remark from somebody, but it seldom seems to sink in. Several factors conspire to prove this assertion, and failure to recognize them and their cumulative effect has perhaps done more than all else to bring to an untimely end the careers of many budding engineers.

Class Load

Of first importance is class load which for the average engineering student is at least 20 per cent higher than for liberal arts students. Scientific and technical knowledge has expanded so rapidly in recent years that even by dropping obsolete courses and rearranging others, engineering curricula, even in five-year programs, have been strained to the limit to include all the basic preparation which a mid-twentieth century engineer should have. Any leisurely and reflective pursuit of learning which one sometimes associates with scholars of the liberal arts is out of the question.

The very nature of engineering courses further aggravates the situation. The courses in science and technology require extensive laboratory and computing periods which make your day a full one with many afternoons spoken for until 4:30. If then at 5:00 you could call it quits and except for an hour or so of homework after dinner, you could relax with your hi-fi or a good book, that would be one thing; but if you would be a successful engineering student your homework averages about five hours which means your week's work load will normally amount to sixty hours or more. Quite a change from the customary forty-hour week you have always heard about!

It would be unfair to say that the courses the engineering student takes are in themselves more difficult than those elected by arts students. A selective factor is at work here, and if you choose to study engineering one reason is presumably because you have a flair for these subjects and enjoy them; for you they may be easier than courses in history or fine arts. The intellectual discipline or training of the mind you will receive in engineering will be one of the principal benefits of your training and will apply to most of your work. You will have few courses where mere receptivity to ideas and the ability to repeat them on examinations will suffice.

Hard work, a heavy load, and disciplined mental activity is your lot if you elect engineering. If you are to carry off successfully such an academic life you must have mastered your secondary school work, have perfected your study habits, have a high capacity for sustained application, and a great desire to accomplish what you have set out to do. You must have the ability to concentrate, systematize, and organize your work, make an orderly approach to solving problems, persist in the face of often repeated failures, and thrive on all of this. These are among the makings of a good engineer, and they are certainly essential to the successful pursuit of an engineering education.

There's Time For Activities

At this point perhaps you are saying to yourself, "Engineering? Phooey! I want a professional career, but I want some fun in college, too." Well, don't despair; this is one case where you can have your cake and eat it, provided you will submit to one thing—discipline, both mental and physical.

Among the happiest, ablest, and most successful college students I have known are many engineers. They are often campus leaders, play an active and constructive role in student social life, organizations, and athletics. The question need not be between athletics and engineering; seven of the nine men in Cornell's famous 1957 crew which won the Grand Challenge Cup at Henley, England, and many other honors, were engineers. And engineers abound throughout the entire range of sports, as well as in the broad scope of other student activities and organizations.

The key to dual accomplishment in academic life and extracurricular activities is the awareness that in any week there are just 168 hours, that so many of these are required for eating and sleeping, going to and from class, for shaving and brushing teeth, and that what remains is for study and recreation. The plotting of study time and its effective use is essential.

Although you may be only an average student, there is time for relaxation or nonacademic activities, unless of course you are required to devote long hours to remunerative employment. Even then, a surprising number of engineering students have found it possible to lead a full and varied campus life with great credit to themselves and their alma mater.

And it is the very factors which bring about this busy and produc-

Jeffrey Frey

Professor Newhall demonstrates the principle of conservation of energy in his basic physics lecture. This course is a basic part of your training.

tive life in college which are an integral part of the make-up of a good engineer. You can achieve a well rounded college life and the rewarding sense of accomplishment will enrich your whole college career. The fact that as an engineering student you may find it necessary to put forth more effort to achieve what you want will make your reward all the sweeter.

The First Years On Faith

Your motivation, your interest and enthusiasm for what you are doing, have much to do with your success in engineering college. Unfortunately, the freshman engineer is seldom fully motivated, nor can he be expected to have at that time of his life a naturally consuming desire to be an engineer. Some interest you must have or you would not have chosen engineering school, but in large measure your motivation to become an engineer is a product of your development in engineering school, and this means that at the outset you must act a good bit on faith. Without utterly clearcut motives and the certainty that you are tackling the right career, with all the natural doubts which assail all young men in their teens, and in the face of a flood of changing interests which will confuse your long term objectives, you may have to accept somewhat blindly the rigors of your first year or two in engineering school.

Maybe you have heard that a large number of engineering students fall by the wayside, especially in the first year of their engineering course. Unfortunately, this is true and you should know that one of the principal reasons for this mortality, or attrition as the colleges call it, is lack of proper motivation, and I would add, failure to understand what engineering school is all about. Lack of ability is seldom the reason for failure, for this can be assessed before a student matriculates and the wise school will exclude the intellectually unfit. But how about this factor of motivation?

Motivation

The psychologists will tell you that if a person knows with some degree of certainty what he can do and has an established interest in doing it his accomplishments will be greater than if he lacked this motivation. Applied to prospective engineering students there are few who know for sure that they have the attributes for this profession and fewer whose interests in it are tried and stable. Despite all the psychological testing that goes on, about all we can tell anybody at present about his fitness for engineering is that he does or does not have the requisite intelligence and secondary school accomplishments.

We have yet to find adequate tools which will measure the behavioral characteristics and interests of people who will make successful engineers or engineering students; current measures of interest are far short of being successful predictors. What is more disturbing is that at seventeen or eighteen a young person's behavior, attitudes, and interests are not altogether stable and fully formed so that even if we could measure them accurately they might be descriptive of him today but not for tomorrow.

Upon this foundation of shifting sands most engineering freshmen start their college careers. If you go to engineering school, remember, despite all protestations to the contrary, that a majority of your classmates do not know any better than you whether for sure they have what it takes to be engineers or that their interests are any more valid. You are taking a calculated risk, and the first year of engineering school is more or less of an adventure.

If your first year in engineering school must be experimental, because you have been unable fully to validate your choice of a career, at least you owe it to yourself to adopt an attitude of free inquiry and make every effort to give your venture a fair trial. Your initial impact with an engineering curriculum may not fire your enthusiasm for engineering or vastly increase your knowledge of the profession. To resolve your question you will have to look beyond your first year courses, talk with and observe the work of upperclassmen, ask questions of your teachers and your faculty advisor, and by reading and orientation lectures explore to the limit of your time and abilities the true role of the engineer.

Making The Right Choice

Do I hear some of you saying, "Will the lightning *ever* strike? When *will* I know for sure that engineering is for me?" For most of us the lightning never does strike; interest which motivates us in a career is usually the product of a slowly growing awareness that a particular goal is ours, and this awareness is nourished by familiarity, the gradual acquisition of knowledge, and the satisfactions which come from the achievement of preliminary goals. What I am saying is that your motivation toward a lifetime in engineering will grow as your course unfolds, aided by your efforts and those of the faculty to accelerate the process.

Your friends in liberal arts must wrestle with this problem of motivation, too, but not having committed themselves as freshmen to a program of professional training they are not so acutely aware of the problem of reconciling their ill-defined interests with their college studies, especially when these studies often have little vocational significance anyway. If, by the end of two years, your interest in engineering should have ceased to grow, and provided you may have developed some positive leanings in another direction, then perhaps you should quit engineering school and do something else. But give it a fair trial! This experiment to test or establish your interest in engineering should be an exciting, challenging, and productive experience. As in any research you may be assailed by doubts and failures before

success is won and you must be steadfast in your quest for an answer.

Perhaps before your answer comes you will be tempted to ditch the whole experiment, believing that to continue can only be a waste of time. Let me reassure you! Whether you wind up in engineering, selling hats, or preaching the gospel, the net result of any amount of engineering education will be a gain. Most engineering graduates follow careers which utilize the technological training they have acquired, but graduate engineers may be found in medicine, law, teaching, business, journalism, and the ministry, and I have yet to meet any one of them who regrets his training as an engineering student.

The Training Is Valuable

And why should he? What employer anywhere will not look with favor on the young man who brings to his job a disciplined mind skillful in its orderly approach to solving problems; a temperament inured to hard work, and the capacity to persevere in the face of difficulties and discouragement or failure; and an understanding, by virtue of his knowledge of science and mathematics alone, of forces governing our modern world which are frequently a mystery to other college graduates?

All right, you may say, I'll buy this, but how about the liberal arts? Can I afford to neglect this phase of my education? My answer to this is, you won't have to. If in your engineering curriculum you will take full advantage of the prescribed and elective courses available to you in the humanities (languages, literature, fine arts, etc.) and in the social sciences (such as psychology, economics, anthropology, and sociology) you will have had sufficient exposure to these subjects to enable you to pursue them further and to your heart's desire throughout your life. The graduate in liberal arts may by the time he graduates have had more formal preparation in these fields, but it is still only a beginning, and bear in mind that *all* of his professional or specialized education is yet to be acquired, whereas you will have largely completed your vocational training.

You must always realize that one's education is not solely a product of the classroom nor that it must all be acquired before age twenty-two or twenty-three. The great books are always here for you to read and think about; the great minds are yours to listen to; the music of all ages is yours to enjoy on hi-fi, by radio, or in the concert hall; and the masterpieces of art and architecture whether in books, in the gallery, or in the market place are yours to study and enjoy.

This rounding out of your education need not be deferred until you get your engineering degree; the campus of any university will offer the engineering student myriad opportunities outside the classroom to explore the world beyond the realm of science and technology. On the other hand, any man who would fit himself for membership in the fellowship of educated men must pursue an extended self-imposed program of adult education upon graduation from college, be his degree in engineering, liberal arts, or horseshoeing.

An engineering education calls for the best that is in you and helps develop that best. It is not all beer and skittles, for it is a rigorous and demanding intellectual discipline. The bridge builder or the missile maker cannot afford to be right only 70 per cent of the time; for the safety, comfort, convenience, and economy of millions of people he must strive for perfection in machines and structures, and in the harnessing of all natural forces. His education is a solemn challenge to these ends. Engineering school should not be a burden but an opportunity and if as a young man or woman you are prepared to study engineering with some better understanding of what it means than perhaps you had before, these reflections on what an engineering school is like will have served their intention.

The majority of your time at college will necessarily be spent in studies, but that doesn't mean there's no time for fun. These students are combining their technical interests with some extra-curricular work. They are demonstrating some of their engineering work at an Engineers' Day exhibition.

MY VIEW AS AN ENGINEERING

Fifth year engineer evaluates his first four years of training and comments on some of the pitfalls he has discovered.

by Alan S. Rosenthal EE '60

My Dad was about to sign my ninth tuition check when he looked up and asked, "Well, if you had it to do over again, would you?" Now I am not going to pretend that the question is the most original ever asked, nor am I going to claim a patent to the one correct answer. My reply is, necessarily, based upon my own experiences which—I assume—are those of a "typical" engineer.

I look at my last four years of engineering as a source of great satisfaction. I have no doubt, though, that if I had the opportunity to do it over, there are a number of pitfalls and difficulties that I would like to avoid.

There are few fields of study that are more difficult and exacting than engineering, but the satisfaction you get after completing one of the toughest courses a school has to offer is unmatched. There is, however, more than satisfaction to be gained from engineering. The rigorous training you get in clear, logical reasoning is well worth the effort.

I do not recommend engineering to everybody. In fact, those whom I do encourage to study engineering have been—though they probably don't realize it — highly complimented. A successful engineering student usually has a high order of intelligence, an interest in science and math, and an insatiable curiosity. But even with all of these, he has a challenging course of study before him.

I did a great deal of thinking before I decided to study engineering. My high school, like many others, has an intensive program of career study. I can still tell you the outlook for engineers in the next five years, probable starting salaries, chances for advancement, and a host of other items all pointing to engineering as the profession with a future. My college boards confirmed my ability, my interest tests showed that I was in the right area of study, and I was all set to start teaching my professor a thing or two about calculus.

My thinking in this direction was a bit warped, but I did have plenty of faith. I had made up my mind to do something I knew I could and wanted to do, and nothing was going to stop me.

Freshman Class

Our freshman class was a large group of pretty uncertain people whose main concern at the moment appeared to be what type of slide rule to buy. Some of us had never removed a tube from a portable radio. A few weren't sure of quite how to open the car hood. But those of us who will be graduating in June had one thing in common—we had made up our minds to give it our all.

Some of my classmates boasted about the manner in which they slid through high school without cracking a book. Then there were those who decided to spend the term acclimating themselves to the

Photo Science

Proper budgeting of time is a serious problem for many students. Finding time for such worthwhile activities as this tour of the White Art Museum without slighting your studies will require a carefully arranged schedule.

STUDENT

Sophomore engineer views the effect of mutual inductance in physics lab. Although such work may, at first, seem to be unrelated to your particular area of engineering, you will find that this basic scientific background is the core of engineering and essential to your later work.

University's social activities leaving studies to the sophomore or junior year. I don't see them around campus anymore.

The freshman year is never quite what you expect. We were all pretty well oriented to something called "college life," but no one was fully prepared for the shock of class from 8:00 to 4:30 five or six days per week.

One thing becomes apparent pretty quickly. We have a choice of a branch of engineering. From then on, courses, schedules, and programs are planned for us. We all knew just where we were going. So many hours are prescribed: take them, pass them, get a degree, and be an engineer. The regimentation seems annoying at first, but most of the early courses are in math or science, and the opportunities for inquiry and discovery are boundless. These subjects have always interested me, and on a college level they become fascinating.

Basic Courses Important

But something else about my program was a surprise. As far as I could see, there were no engineering courses. Naturally I had drawing, but when would I get into the engineering labs? What about machinery, materials, and electronics? Sure I had physics, math, and chemistry, but they began to seem less and less like what I thought was engineering.

The lack of what are considered by many to be engineering courses during the first year is no small problem. All of us who enrolled in engineering were eager to dip into the grease, solder, and cement of the labs. The fact that most engineering lab courses are not scheduled until the junior year is often enough of a surprise to cause students to lose interest or feel that freshman and sophomore courses are worthless. I will never forget my freshman advisor's stern remarks when, after doing poorly in a physics exam, I walked into his office and told him that I wasn't too worried since it wasn't really engineering.

How wrong I was! Those basic courses are the core of engineering. Basic mechanics is just as important to the EE and ChemE as to the ME and CE. I am continually going back to those basic principles.

The basic courses are the building blocks for methods of thought and analysis that it takes most of us four or five years to envision. Those of my classmates who shrugged their shoulders and said they would wait for the meat of the engineering program in their junior or senior years usually were denied the opportunity by the academic committees.

In some ways it is unfortunate that the freshman year should be so important. During this year, we are going through a difficult period of adjustment to a new form of life. I have no doubt that when people say the freshman year is the hardest they are referring to this adjustment problem.

I found that most of the difficulties boiled down to the proper budgeting of time. Several times during my freshman year I sat down and tried to see just where all my time was going. On a number of these occasions, the result was a worthwhile redirection of my efforts to areas in which I needed to do more work.

In discussing this matter of time, I don't mean to imply that every waking hour must be devoted to study. Activities, sports, fraternities, entertainment, and just plain relaxing should all play important parts in any schedule. The cliche "all your education is not obtained in the classroom" is hackneyed but true.

In the rush of freshman orientation week, I signed every activities list that passed through my hands. During the first week of classes I realized my mistake and narrowed the list to two or three. The time I have spent with these organizations has been considerable, but, as long as it is kept within reasonable bounds, it is highly rewarding.

Work Gets Harder

Although everyone assured me that with freshman courses behind me, I could ease up, I was not entirely satisfied with my performance during those first two terms, and I decided to work harder during the second year. My decision was a wise one. I have since discovered that the work gets harder rather than easier. The junior year is tougher than the sophomore year, and the senior year is harder than those preceding it.

These degrees of difficulty are no accident. Engineering education is hard and rigorous. Having completed one phase of work, we are better equipped to do advanced thinking. It would be absurd if courses got to a point where we were given a chance to rest on our laurels. The best part of engineering is that we are continually required to work at peak capacity.

I don't pretend that such a program is easy. There are many frustrations and discouragements in the senior year as well as in the sophomore. But I find that the realization that I have been successful before is an encouragement to keep going and come through again.

A Time For Re-evaluation

The conclusion of the sophomore year is a big turning point in an engineering education. At this time we have completed most of the basic and general courses and have had a slight smattering of hard-core engineering laboratory work.

At that point in my career, I had a number of misgivings. I realized that I would never be able to take all the humanities courses that I had hoped for. I began to feel that my friends in the Arts College were much better off than I. Weren't they getting a real education while I was being left by the wayside?

Undoubtedly the arts student gets a type of education that an engineer cannot gain. As an engineer, however, I am getting a professional training at an undergraduate level. I know that at graduation I have excellent job opportunities in a field that I enjoy. My Arts College friends, on the other hand, found last March that the employment picture was not all they had hoped for, and many enrolled in graduate school where they will now start to receive professional training.

Another consideration is summer-job opportunities. I found as early as my sophomore year that engineers were in far greater demand than anyone else for summer jobs. Moreover, the salaries are generally higher than those available to non-engineers.

The money aspect of summer jobs is, of course, important. But of far greater value is the opportunity the summer provides to get a picture of what engineering work is really like. I have found such tastes of industry an important factor in my decision to continue my engineering studies.

Aside from the opportunity for summer employment offered by the three-month vacation, there is a chance for reflection and relaxation. During several of my summer vacations I took evening courses in nontechnical areas. I found that engineering did not dull my interest or ability in humanities, and that I not only held my own, but more often than not came out on top in courses such as philosophy and literature.

That the type of training we are given is useful in non-engineering areas as well as technical ones becomes more and more apparent as time goes by. The courses that we take in the junior and senior year provide training in a specific area of engineering. They are also applications of the basic theories over which we labor in our freshman and sophomore years. The general methods of problem solving learned during the first two years are methodically applied to practical laboratory problems while our abilities to think and reason are continually sharpened.

And now I have reached my fifth year. Would I do it all over again? Am I glad I took engineering? I know this: when I get my degree in June, it will mean that I have put forth my very best efforts and have mastered some of the most difficult work that a university has to offer. It will mean that I have developed my mind to a point where I can collect and analyze data so that I can arrive at sound conclusions whether the area be technical or not. The business world I am entering is one of hard knocks, but I am well equipped. I am confident that I am ready to tackle its problems.

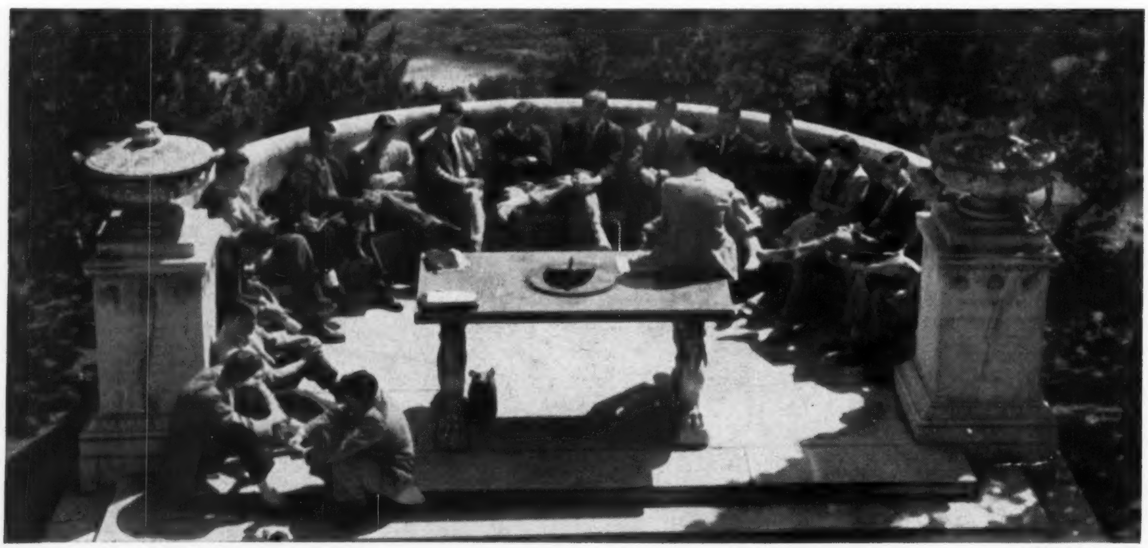

Photo Science

Warm spring weather comes to Ithaca, and many arts courses move outdoors. The area around Goldwin Smith proves ideal for this type of informal discussion group as it convenes around the sun dial. Students taking this kind of course are drawn from every college of the University. Engineers find that they are just as well qualified to take part in philosophical or literary discussion groups as their arts school friends.

THE CHALLENGE TO THE GRADUATE ENGINEER

Engineers usually take one of two paths after entering industry. The technical and managerial paths are compared and contrasted.

by Edward E. Foster

This nation has the highest standard of living, measured in material goods, of any on earth. It has been achieved by our genius for production. As new scientific knowledge has appeared, we have been quick to apply it to new products and to new methods of industry and agriculture. We have maintained our high standard of living by our inventiveness, ingenuity and ability to be continually more productive. Today, much of our engineering talent is being directed towards military defense, with the prospect that this will continue to be so for years to come. Even assuming that we can continue to prevent a catastrophic war, we shall continue to be faced with increased economic competition. Russia and China are making enormous industrial progress, by the same paths of engineering and industrial advances which have been so successful in this country. We shall have to run fast to stand still. Our position of leadership in the free world can be maintained only if we are able to continue to increase our productivity, for we shall surely be priced out of some of the world's markets unless we do. We are committed to many trends, both military and non-military, which demand a continuous influx of new techniques and products.

These needed increases in productivity must be based upon sound engineering. Never in the history of the world have there existed so many challenges to engineers. They are needed in so many kinds of organizations. Space will permit us to do no more than touch on highlights of job opportunities open to graduate engineers. Figures 1 and 2 give some idea of the scope of their activities.

There are two broad professional paths along which an engineer can advance. One may be described as technical; the other as managerial. These paths are not distinctly separate. They overlap in places and cross in others. In the first few years after obtaining his academic degree, the engineer is most likely to travel along the technical path, for he will be learning to apply the skills he has acquired in his formal education. As he acquires practical experience, he will become increasingly aware of the existence of the two routes and will eventually have to choose between them.

Managerial Path

Let us first consider the managerial path. The sequence of events may be defined loosely as LEARNING, DOING, SUPERVISING, DIRECTING, and finally, MANAGING. Awareness of the necessity for choice probably first occurs to the engineer when he is asked to become a group leader. As he becomes responsible for the effectiveness of other engineers, he can no longer devote his entire time to

About the Author

Edward E. Foster is currently Assistant Technical Director—Administration of the Cornell Aeronautical Laboratory, Inc. He received his B.S. in Aeronautical Engineering from the Massachusetts Institute of Technology, and has had 25 years experience in aircraft engineering. Before coming to CAL Mr. Foster was associated with Curtiss-Wright Airplane Division and Fairchild Guided Missiles Division. His experience has been in the fields of research, development and production.

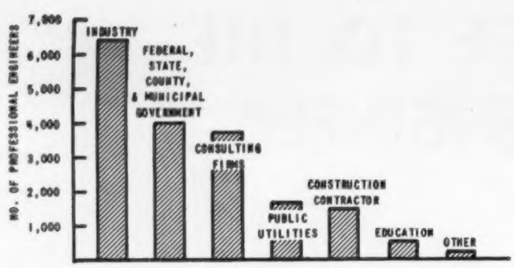

Figure 1

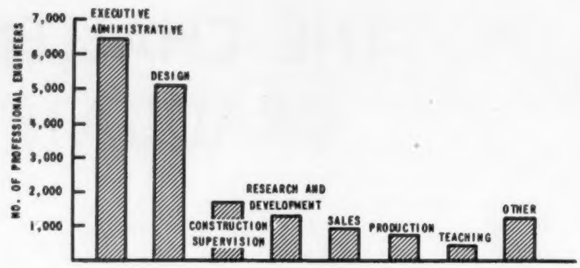

Figure 2

DOING—he must apply some to guidance of others. Increasingly he becomes acquainted with their plans and procedures, evaluates their ideas and critically examines the validity of their analyses and experiments. In proportion to his managerial success he will be promoted to successively higher echelons of supervision.

The time available for detailed participation in any technical endeavor continues to decrease as he moves up the managerial ladder and becomes concerned with increasingly broader aspects of the endeavor. Breadth of his technical knowledge and understanding increases at the expense of depth in any one specialized field. His decisions choose the way for each task to proceed; for one of the things we learn quickly is that real problems, unlike those in textbooks, often do not yield a single solution.

Textbook problems are carefully designed to teach, to lead the student to an increasingly deeper understanding of the subject. Real problems usually provide insufficient data to permit an unequivocal answer, so someone has to make a decision as to which partial solution to accept, and where to proceed next. The engineers who respond capably to these challenges eventually find themselves in such a position as Director of Research, Chief Engineer, or Director of Manufacturing.

Technical Path

The engineer who chooses the technical path does so in most cases because he gets his greatest satisfaction from direct participation in the solution of technical problems, as distinguished from the guiding of others in their participation. In contrast to the managerial, he LEARNS and then continues to DO as long as he stays on the "technical" path. In the first place, and perhaps most importantly, he is the man who *does* the engineering. Without him, there would be no one for management to manage. For every engineering supervisor there must be many technical engineers.

In the past there were few paths of promotion for the man who preferred to avoid managerial activities, or at least to minimize their demands upon his time. Fortunately this situation is improving. The engineer who prefers the more technical aspects of the work has increasingly greater opportunities. More and more, those in management are recognizing the undesirability of forcing into management the engineer who wants to devote his efforts to direct technical achievement rather than the direction of people.

The complexity of present-day devices such as automatic machinery and weapon systems requires that engineers of many diverse skills and disciplines work together, supplementing each others' capabilities, to achieve an integrated whole. Such teams include both technical and managerial engineers. They may be small or large; in some instances including subteams from several companies. They have come to be accepted as the normal way to performing engineering. But let us remember at all times that such developments usually rest solidly on the basic idea of one man. That idea probably is one of many which he examined, tested, and rejected. Some of the ideas were probably further tested by a small group for practicability and in this examination a few more ideas usually die. Finally, one idea is considered worthy of development; and by that time the engineer who originated it is probably back in his office or laboratory attacking a new and different problem.

The Individual Investigator

We sometimes hear it said that the day is past for the investigator, or inventor, who works alone in his laboratory. We disagree. At the Cornell Aeronautical Laboratory, Inc., in Buffalo, we recently noted the following assignments of engineers and scientists to research and development projects:

Number of Projects	Number of Engineers Assigned
30	1
15	2
15	3
4	4
4	5

We believe that this is typical of much research and early development.

On organizational levels equivalent to nearly all supervisory ones are staff positions which are open to the technical engineer. Jobs are continually being created which are designed to take full advantage of the particular skills of individuals, instead of trying to force them into standard niches. In such positions, an engineer's contributions may range from creation of new techniques and new products to giving technical advice to other engineers or to management.

The tempo of the cycle of scientific discovery to engineering application to production to obsolescence is increasing with our technologic growth. New scientific inputs are being consumed voraci-

ously. A substantial number of the engineering profession must pursue advancing scientific research so deeply into its lair—must participate on terms of such complete ease and familiarity in the clarification and interpretation of new idea structure—as to become almost indistinguishable in education and interest from the abstract scientist. Indeed the only basic difference is the engineer's motivation to useful application rather than generalized curiosity. Such engineers are rare. They develop a gift of intuitive judgment and uncanny insight. Without them, invention fails.

We have discussed the two paths of professional development of the engineer as though they were completely separate. However, the amount of time which an engineer prefers to devote to managerial activities in contrast to direct participation in technical pursuits varies with the individual. Fortunately, a job is seldom purely technical or entirely managerial. Usually it combines both types of activity, in varying proportions. The engineer who leans predominantly towards the technical is often attracted to teaching, frequently combining with this some industrial consulting. In industry he is often found in the Research Department, or on the staff of the Engineering Department. He may carry such title as Staff Engineer, Principal Engineer, or Consultant. He may be a specialist in one field such as Radar, Antennas, Servos, Human Factors, for example. The managerial engineer may be concerned with these same specialized fields, but he will usually carry such a title as Group Leader, Section Head, or Department Head.

Remuneration

What an individual receives in return for his devotion to his job consists of many things. Salary is obvious, and so-called fringe benefits are now considered essentially a part of salary. However, there are often intangibles which are given considerable weight by the engineer in his choice of jobs. Often to the technically oriented engineer, creative freedom looms large in importance. This does not imply that he insists on having his own way regardless of circumstances; but rather, he wants to be sure that he will be allowed to work in an atmosphere of intellectual honesty, and that due consideration will be given to his ideas. Nevertheless, salary continues to be a relatively universal indication of a man's status. Presented in Figure 3 are the salaries of some 190,000 engineers employed in many types of jobs in many industries.

We have discussed functional characteristics of engineering jobs rather than product orientation, since they apply equally well, for example, to an automobile, airplane, or weapon system. We have stressed engineering activities for the engineer, for in most cases they will be his choice, whether vectored towards the technical or towards the managerial. However, the increasing complexity of modern technology requires a continuous input of technologic understanding at planning and management levels—requiring a pattern of aptitudes and drives which are by no means common to all engineers. Assessment of the effects of technological developments upon the company's program requires awareness and understanding of the many non-technical facets of the company's management. Considerable skill in communications is always necessary. In spite of considerable progress in broadening the engineering curriculum, the engineer must still make a conscious effort to make his professional knowledge effective in team effort with other arts of management.

The pattern of the future challenges our young engineers to attempt, in the much too meager time available to them, to integrate engineering application with advanced science and mathematics in one area or with the humanities and economic theory in another. To relieve our future dependence upon imported science for engineering innovation, it may be necessary to sacrifice foundary practice for a better base in solid state physics and integral transforms. Furthermore, an engineer who has undertaken some economic geography and political economy will not find that the time had been wasted. Most of us become steeped soon enough in the specialized lore of our own company or industry. The uncommitted college period should be reserved for generality and breadth.

It is our deep conviction that the future can be an exciting one for every engineer, whether he chooses the technical route or the managerial one. The real challenge is in making the most of each separate opportunity.

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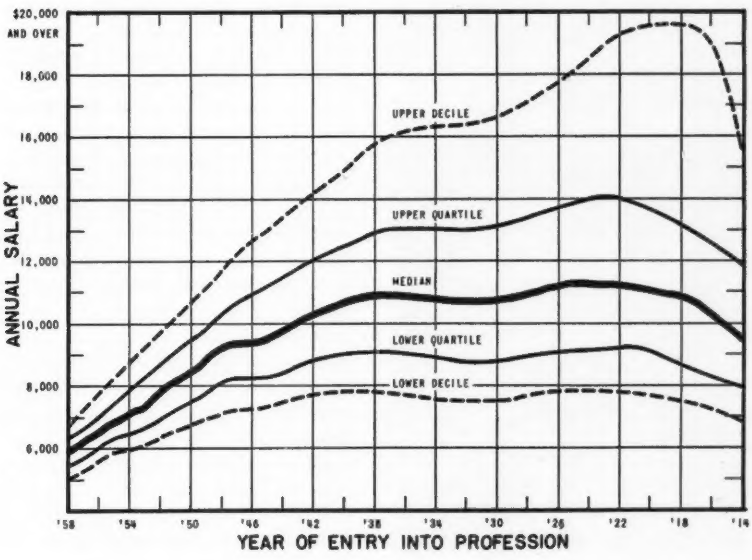


Figure 3

Figures 1 and 2 are taken from "Professional Engineers' Income and Salary Survey, 1958;" National Society of Professional Engineers, Washington, D.C.

Figure 3 is from "Professional Income of Engineers, 1958" EJC Report No. 112, Engineers Joint Council.

SCIENCE OR ENGINEERING?

Dividing line between engineering and science is vague, but a basic distinction is that engineering is the application of knowledge that science discovers.

by Dean Dale R. Corson

Students with an aptitude for mathematics and technical subjects in general often decide to study engineering in college only to discover that they are most interested in pure science. They therefore must redirect their academic programs. Sometimes this redirection is from science to engineering. The original selection of field and the subsequent change are often made without a clear understanding of the differences between science and engineering. My purpose here is to try to clarify these differences, with the hope that I can help students make the proper selection initially. At the same time I want to point out that science and engineering are moving closer together, so that regardless of the field in which the student ultimately makes his career, the initial choice of college course has become less important.

About the Author

Dale R. Corson, the new head of the College of Engineering has been at Cornell University since 1946. He first served as an assistant professor until 1947, when he became an associate professor. In 1952 he was made a full professor and four years later he was elected chairman of the Department of Physics, a position he held until he became Dean of the Engineering School on July first of this year.

Dean Corson received his B.A. from the College of Emporia in Kansas in 1934 and he received his M.A. a year later from the University of Kansas. He did Graduate work at Ohio State University and later at the University of California at Berkeley where he was awarded his Ph.D. in 1938.

Before coming to Cornell, Dean Corson did research work at Berkeley where he synthesized a new element named astatine. He joined the Radiation Laboratory at MIT at the beginning of the war where he did research and development on radar. In 1945 he became a member of the staff of the Atomic Energy Commission's Los Alamos Scientific Laboratory.

Photo Science

Basic Difference

Basically, the distinction between science and engineering is simple. Science is concerned with the discovery of knowledge and engineering is concerned with the application of already discovered knowledge. The scientist is interested only in understanding some aspect of the world in which he lives. The engineer is interested in the design of some well-defined end product which has a useful application. Let me cite some examples where this distinction is clear. The formulation of the laws of mechanical motion by Newton in the seventeenth century was science, while the application of those laws to the design of a rocket motor is engineering. The discovery of the laws of electromagnetic induction by Faraday and by Henry, 130 years ago, was science, although the application of those laws to the construction of an electric generator some fifty

years later was engineering. More recently, while the discovery of uranium fission in 1939 by Hahn and Strassman was clearly science, the design of a nuclear reactor core today is engineering.

Sometimes the distinction is not so clear, as in the case of the studies by Shockley, Bardeen, and Brattain, concerning the motion of electrons and holes in semi-conductors and the consequent development of the transitor in the late 1940's. Was this science or was it engineering? Was the transistor "discovered" in the course of a scientific study or was it "invented" as part of an engineering development? The studies of semi-conductors which led to the transistor were scientific studies. The transistor came directly from these studies and was developed by the same people, so it can be claimed as a scientific discovery. On the other hand, its significance lies in its application to engineering problems so that it can equally well be called an engineering development. What we call it is a matter of taste.

The distinctions between science and engineering become hazy where: 1). the period between discovery and application is short, as in the case of the transistor, 2). the engineer needs scientific information in a field that has not been fully explored, or 3). the solution of an engineering problem requires the engineer to dip deeply into the store of existing scientific or mathematical knowledge. These three categories are somewhat arbitrarily defined and the last two stem to a considerable degree from the first.

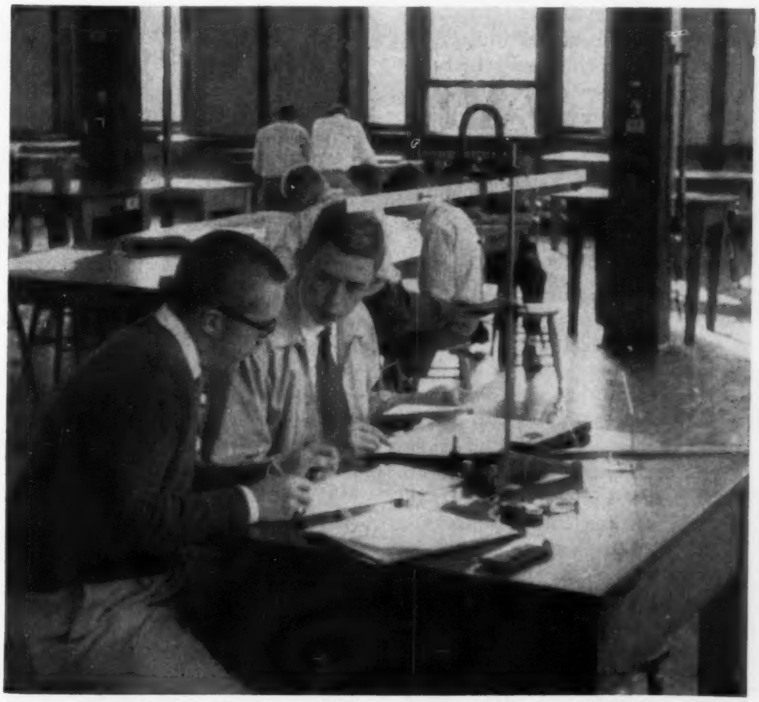
The Three Categories

A good example of category one, where there is a short period between discovery and application, is the "Maser." This is a device in which very weak, high-frequency radio signals can be amplified through the inter-action of the radio waves with the magnetic moments of atomic systems in suitable materials. The solid-state Maser was first proposed in 1956. Almost immediately low-noise amplifiers based on it were under construction. Subsequently, a whole series of other Maser-type devices has been invented and built by people who were trained as physicists in some cases, and as engineers in others. They have all been concerned, however, with both science and engineering. Without understanding the physics of the device they would be lost. And without an interest in building a device to be used for engineering purposes, they would not be concerned with Masers in the first place. They are scientists and engineers at the same time.

Fluid dynamics in high velocity air flow is an example of category two, where a field is not adequately explored. The fluid mechanics applicable to airflow over wings at high velocity had not been fully developed when designs of supersonic aircraft were initiated. This was an area of scientific investigation which had not attracted study in the breadth and depth required for engineering applications. As a result, aeronautical engineers attacked the problem with vigor on both the theoretical and on the experimental side, with the result that the thermodynamics and aerodynamics involved were worked out. These studies were applied to the engineering problems involved, the swept wing and delta wing were developed, shock wave troubles were cleared up, and supersonic aircraft were produced.

Another example is the case of an engineer who wishes to design a nuclear reactor to operate at such high temperatures and in such corrosive atmospheres that no existing metal is suitable as a structural material. If the science of materials were far enough advanced, the engineer could utilize the established principles to design an alloy for his purpose. Since the basic science is not available, the engineer must experiment himself with new metals and new alloys to try to find one which is suitable. In the process, he may make studies to understand why a small amount of one metal alloyed with another has such profound effects on the properties of the second metal. In this effort, the engineer's work is hardly distinguishable from that of a physicist studying metals. The engineer, however, always has the design of his reactor in mind; he has the application directly before him.

An example of category three, where the direct application of existing knowledge requires extensive



Engineering students taking a basic physics laboratory learn basic scientific principles. Strictly speaking, this is a science course, but these students will soon begin to apply their scientific knowledge in their particular branch of engineering.

scientific analysis, is again the case of the aeronautical engineer trying to understand shock waves. He finds that the thermodynamics of the gas in the shock front is not at all what he predicted from his fluid dynamics theory, which he had extrapolated from the behavior of gases at lower temperatures, pressures, and velocities. The explanation of the discrepancy lies in the fact that the temperatures in the shock waves are high enough to excite molecular vibration or rotation states that are unfamiliar to the engineer. These vibrations and rotations absorb energy from the shock wave and completely change the specific heat of the gas, thereby changing the thermodynamics of the system. Without insight into the atomic and molecular properties of the gas, the engineer would be lost.

A second example of category three, is the case of an electronics engineer who wishes to design a complex communications system. He must understand information theory. He must decide whether to use a pulse-coded system or an ordinary FM system. If he selects pulses, he must decide whether to impress his signals on the pulses by varying the pulse width or by varying the pulse separation. To make this analysis requires advanced mathematical techniques which, at first sight, may seem to be more the tools of a scientist or mathematician than those of an engineer. He uses these tools, however, to help him design his communications system.

Vague Line of Distinction

In each of the examples cited above the engineer uses techniques or makes investigations which are essentially scientific in nature. In a narrow view of the engineer's work in these cases one cannot distinguish the engineer from the scientist. In a broader view, however, one sees that the work of the engineer is always directed toward some useful application. The pure scientist, on the other hand, is seeking knowledge for its own sake.

The engineer who studies the properties of unusual metals may go rather deeply into the subject before he finds the alloy which solves his problem but, once he has solved his problem, he goes ahead with his engineering design. The physicist, on the other hand, who studies the same problems is only trying to understand the atomic phenomena involved. If he solves one problem, he goes on to another with the hope of developing a complete understanding of all the basic atomic processes involved.

Sometimes, however, the line between science and engineering cannot be drawn at all, as in the case of an electrical engineer who works in the field of radio astronomy. If he is not a competent radio engineer, he cannot design the apparatus he requires for his studies; if he is not a competent astronomer, his work is apt to be trivial. He must be both engineer and scientist to work in such a field. Whether he calls himself an engineer or a scientist depends on what he studied as a student and on who pays his salary.

All the above examples point up an important fact of present-day technology—science and engineering are moving closer together. The pace at which new scientific information enters the technological world is so fast that the engineer often must be a competent scientist in his own right to be able to design the engineering product with which he is concerned.

Responsibility To Public

There is another factor which characterizes the engineer, especially in the more traditional engineering fields. This is the engineer's responsibility to the public. If a structural engineer designs a bridge, the bridge must be completely safe under all possible conditions. At the same time the design must be economical to build and pleasing from an aesthetic point of view. The engineer must be sure that he has exercised good "engineering judgment" in his design. He must be sure that his product will perform the job to be done, will be producible, will be reliable, and will be easy to service. The physicist studying mesons, however, has no similar responsibility. He is concerned only with learning as much as possible about the subatomic world.

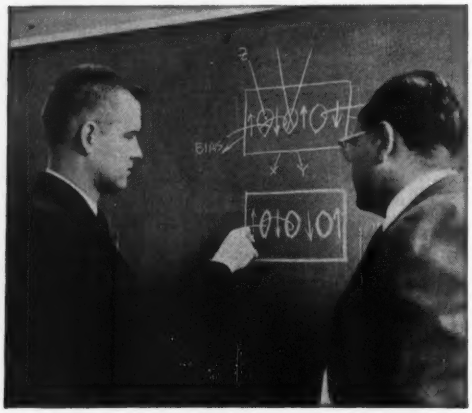
To sum up, the work of the engineer is distinguished by the useful end to which it is directed, even though the techniques employed are often those of the scientist. The scientist is seeking knowledge simply to understand the world in which he lives. However, with the rapid pace of current technology, the engineer is using more of the techniques of the scientist and is digging deeper into the store of recently accumulated scientific information. For this reason the training program of engineers in recent years has moved closer to that of scientists.

In the age of manned satellites and space exploration it is inevitable that this trend will continue. In consequence it makes less difference through which door any given student enters the general field. There are engineering curricula from which students may go in the scientific direction or in the engineering direction with equal facility. Engineering Physics at Cornell is an example. In the more traditional fields of engineering or of science, however, it is still important at present to make a proper choice of field in the beginning. It is difficult to go into chemistry with a background in mechanical engineering, and it is equally difficult to go into civil engineering with a background in physics. These difficulties probably will decrease in the future as engineering and science curricula attain greater similarity.

If you must decide whether to study science or to study engineering, how shall you make up your mind? If you are primarily interested in designing or building things and in development of useful products, then you are most likely headed toward engineering. If you are interested in experiments and in the theory with which natural phenomena are understood, then you are probably headed toward science. If you choose correctly in the beginning, your progress toward a career will be easier. If you choose incorrectly, you will be able to find many places where science and engineering come close together, so that you may be able to redirect your program without undue loss of time and effort. In any case an awareness of the close working relationship and the differing end objectives of science and engineering will enable you to derive greater value from your college experience and professional career.

Product Development at IBM

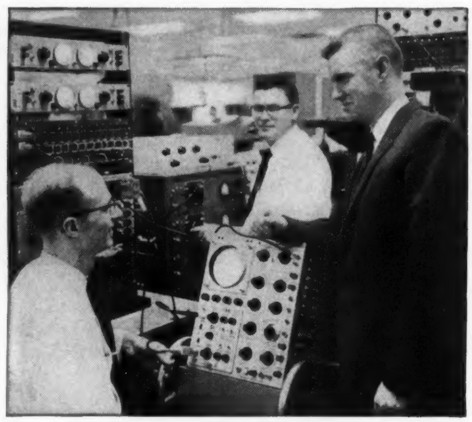
IBM Engineer Richard R. Booth
explores electronic frontiers
to develop new, faster and
larger storage devices
for tomorrow's computers.



Computing time cut from six months to one day

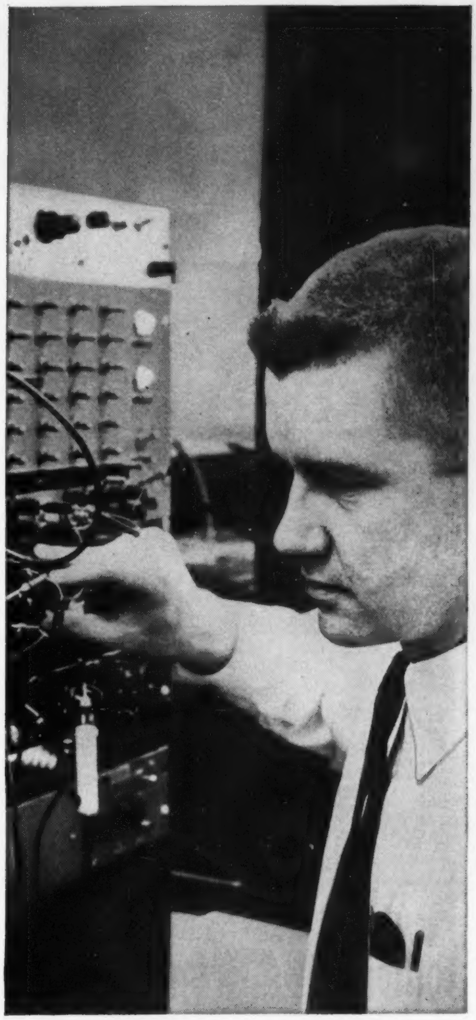
"My job is to design and develop new, high-speed storage devices for a powerful new computer that will perform, in one day, operations requiring six months on present equipment," said Dick Booth as he began a typical day recently. A product development engineer at the IBM Laboratories in Poughkeepsie, N. Y., he started his morning with a conference on a product of great interest to him: a magnetic core storage device with a nondestructive read-out feature. For an hour, he discussed with circuit design engineers the logical devices needed for the register—such as magnetic core drivers and sense amplifiers. Should such devices not be available, the group would work on designs for new ones.

Dick Booth next met with members of the Magnetic Materials Group to establish specifications for the magnetic core memory elements to be used in the register. He also discussed with the group the development of equipment to test the memory elements. "This magnetic core register is based on an original idea of mine," he explained. "When you have a worthwhile idea, you will be given a free hand in proving it out, backed by IBM's resources — plus the assistance of skilled specialists."



Increasing responsibility

At 10:30, Dick Booth reviewed the status of the entire project with the two engineers, two technicians, and one logic designer who make up his team. "My present position is staff engineer," he explained. "It's the second promotion I've had since I joined IBM three years ago with a B.S.E.E. degree from the University of Illinois. I know that there are plenty of other opportunities to move ahead. Furthermore, parallel advancement opportunities exist for engineers in either engineering development or engineering management."



Preparing for the future

In the afternoon, Dick Booth went to the 704 Computing Center to supervise some complex precision computations. "You see how quickly the 704 arrives at the answers," he said. "The computer being developed is expected to multiply more than 500,000 fourteen-digit numbers a second and add them at the rate of one million a second. The computer may be used for design computations for reactors, as well as calculations of satellite behavior. Of course it should have hundreds of other applications."

At 3:30 P.M., Dick Booth attended a weekly class on Theoretical Physics that lasted until 5:00. Afterward, he commented, "You know, IBM offers excellent educational opportunities both in general education and for advanced degrees. One of the engineers in my group has just received his Master's degree from Syracuse University, after completing a postgraduate program given right here at the IBM Laboratory."

A chance to contribute

As he was leaving for the evening, he said, "Yes, I'd recommend an IBM career to any college graduate who wants to exercise his creative ability. IBM will appreciate his talent and he'll have the opportunity to work with specialists who are tops in their fields. I doubt that he'd be able to find a more sympathetic and stimulating atmosphere. Furthermore, he'll have the added incentive of contributing to vitally important projects . . . projects that will take him to the frontiers of knowledge in computer electronics."

* * *

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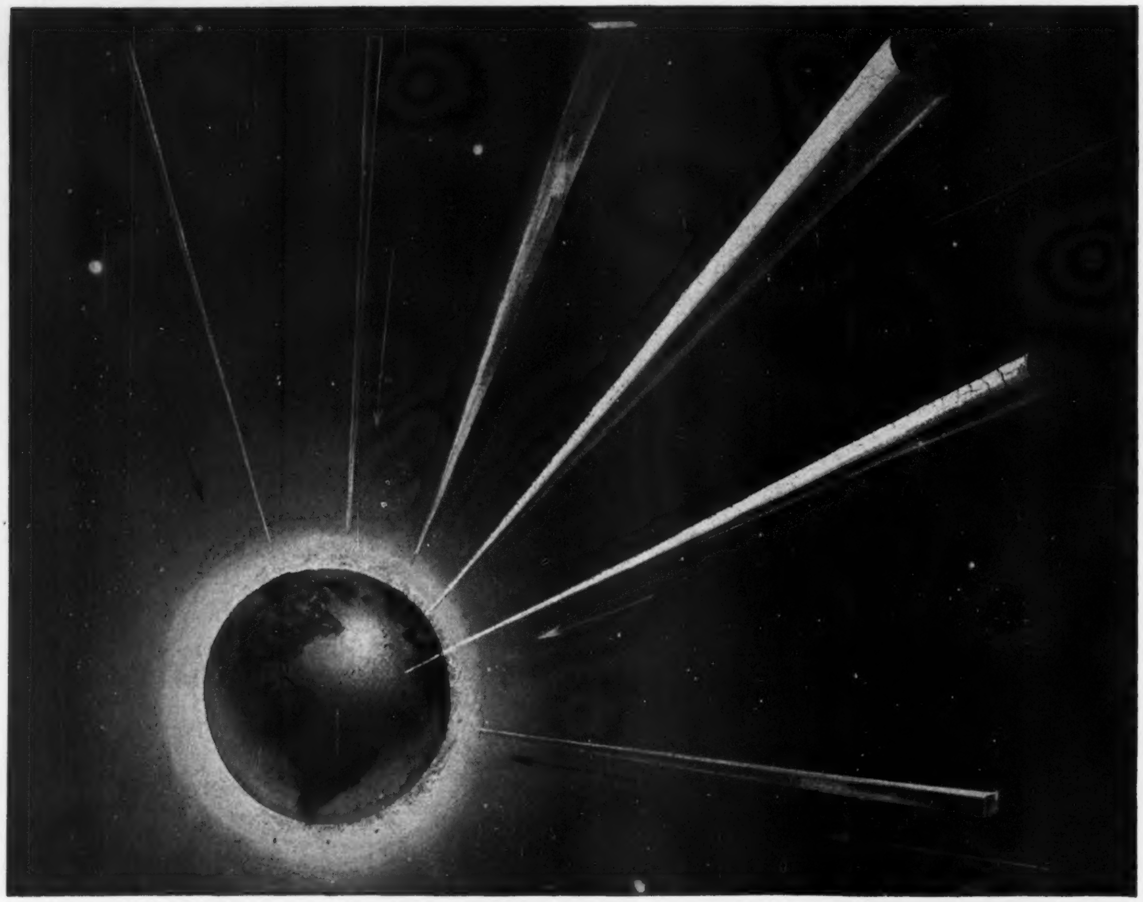

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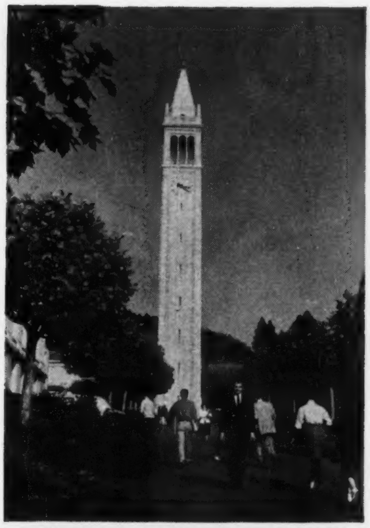
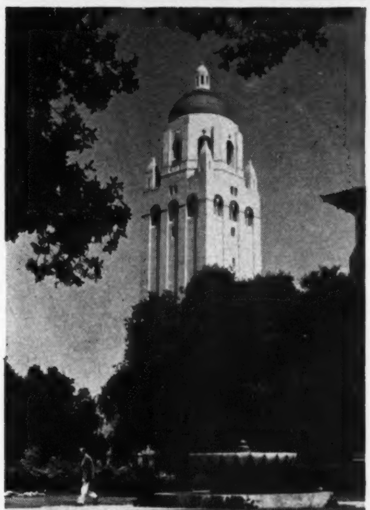
An Announcement of Importance to Engineering and Physical Science Majors





Lockheed Missiles and Space Division is engaged in a broad spectrum of scientific exploration. The Division has complete capability in more than 40 areas of technology – from concept to operation.

Diversity of the work areas is typified by the programs in such fields as: magnetohydrodynamics; space medicine; oceanography; sonics; propulsion and exotic fuels; metallurgy; advanced systems research; manned space vehicles; reconnaissance; optics and infrared; electromagnetic wave propagation and radiation; electronics; physics; chemistry; mathematics; computer design; aero and thermo dynamics; test; design and operations research and analysis.

PROJECTS–Current major projects include the Navy POLARIS Fleet Ballistic Missile; the DISCOVERER program; MIDAS and SAMOS; Air Force Q-5 and X-7 and the Army KINGFISHER. PROJECT MIDAS is an early warning infrared system against ballistic missile attacks, based on the use of satellites. PROJECT SAMOS is designed for the development of an advanced satellite reconnaissance system. DISCOVERER, MIDAS, and SAMOS are programs of the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division with Lockheed as systems manager.

LOCATIONS – You have a selection of two of the choicest living areas in the country at Lockheed. Headquarters for the Division are at Sunnyvale, California, on the San Francisco Peninsula. Research and development facilities are located in the Stanford Industrial Park in Palo Alto and at Van Nuys, in the San Fernando Valley of Los Angeles. Testing is conducted at Santa Cruz and Vandenberg AFB, California; Cape Canaveral, Florida; and Alamogordo, New Mexico.

Together, the Division's facilities occupy more than two million, six hundred thousand square feet of laboratory, engineering, manufacturing and office space and provide the latest in technical equipment, including one of the most modern computing centers in the world.

OPPORTUNITIES FOR ADVANCED EDUCATION – For those who desire to continue their education and secure advanced degrees Lockheed maintains two programs. The Graduate Study Program permits selected engineers and scientists to obtain advanced degrees at the company's expense while working part time at Lockheed.

The Tuition Reimbursement Plan remits fifty per cent of the tuition for approved evening courses for salaried employees who are working full time.

For Information regarding career opportunities at Lockheed, please write Professional Placement Staff, Dept. K-96, Lockheed Missiles and Space Division, 962 West El Camino Real, Sunnyvale, California, or see your Placement Director for date of Lockheed campus visit.

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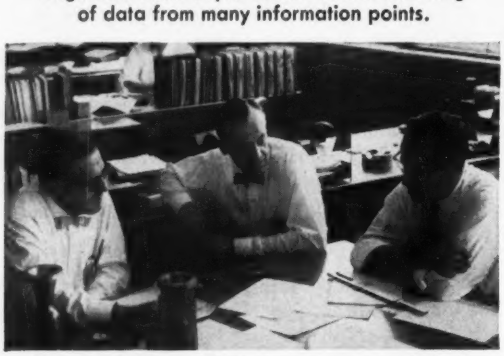
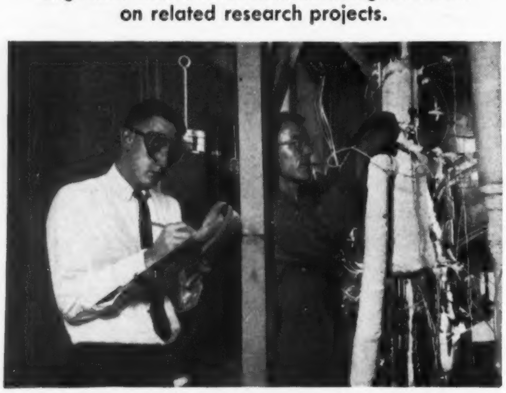


Frequent informal discussions among analytical engineers assure continuous exchange of ideas on related research projects.



Under the close supervision of an engineer, final adjustments are made on a rig for testing an advanced liquid metal system.

Engineers at Pratt & Whitney Aircraft today are concerned with the development of all forms of flight propulsion systems–air breathing, rocket, nuclear and other advanced types for propulsion in space. Many of these systems are so entirely new in concept that their design and development, and allied research programs, require technical personnel not previously associated with the development of aircraft engines. Where the company was once primarily interested in graduates with degrees in mechanical and aeronautical engineering, it now also requires men with degrees in electrical, chemical, and nuclear engineering, and in physics, chemistry, and metallurgy.

Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

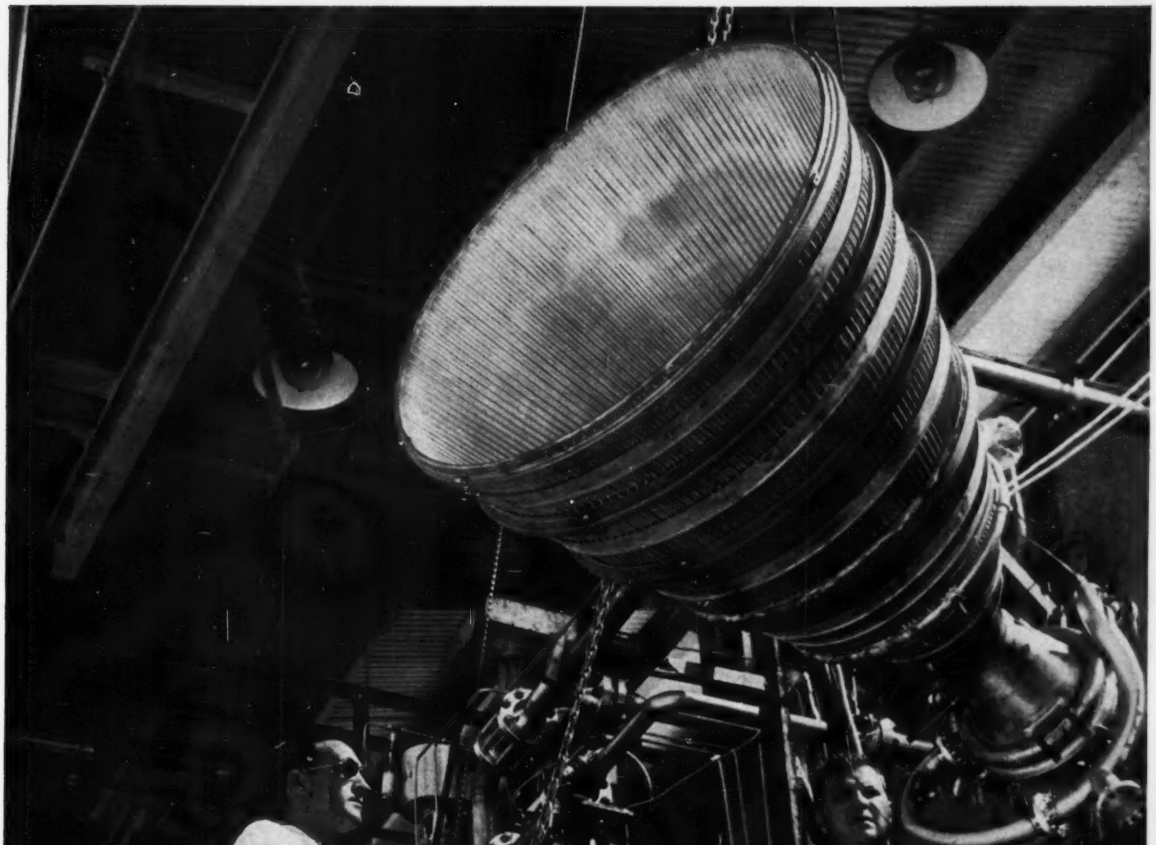
ANALYTICAL ENGINEERING Men engaged in this activity are concerned with fundamental investigations in the fields of science or engineering related to the conception of new products. They carry out detailed analyses of advanced flight and space systems and interpret results in terms of practical design applications. They provide basic information which is essential in determining the types of systems that have development potential.

DESIGN ENGINEERING The prime requisite here is an active interest in the application of aerodynamics, thermodynamics, stress analysis, and principles of machine design to the creation of new flight propulsion systems. Men engaged in this activity at P&WA establish the specific performance and structural requirements of the new product and design it as a complete working mechanism.

EXPERIMENTAL ENGINEERING Here men supervise and coordinate fabrication, assembly and laboratory testing of experimental apparatus, system components, and development engines. They devise test rigs and laboratory setups, specify instrumentation and direct execution of the actual test programs. Responsibility in this phase of the development program also includes analysis of test data, reporting of results and recommendations for future effort.

MATERIALS ENGINEERING Men active in this field at P&WA investigate metals, alloys and other materials under various environmental conditions to determine their usefulness as applied to advanced flight propulsion systems. They devise material testing methods and design special test equipment. They are also responsible for the determination of new fabrication techniques and causes of failures or manufacturing difficulties.

at Pratt & Whitney Aircraft...



Exhaustive testing of full-scale rocket engine thrust chambers is carried on at the Florida Research and Development Center.

For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

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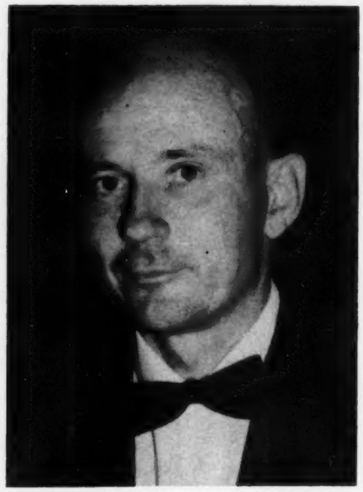


S. D. Teetor

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish closer relationship between the College and its alumni."

THE PRESIDENT'S LETTER—

WHAT IS AN ENGINEER? The other day, while visiting a friend of mine, I was introduced to his son as an Engineer. At that point the son said to his father . . . "What is an Engineer . . ."? After thinking about that remark I wonder how many student Engineers themselves really know what an Engineer is. There are, of course, the hackneyed definitions of an Engineer, such as. . . . "An Engineer is a man who can do for one dollar what someone else does for two dollars."; "The man who runs locomotives"; "The man that runs the big steamshovels". Actually an Engineer is a trained professional man with a certain degree of technical competency who can take on new and challenging problems, and through use of horse sense, ingenuity and technical knowledge, come up with an appropriate solution. Too many graduate engineers who are in the field of engineering never practice engineering. They never get beyond the state of being a combination handbook designer and bookkeeper. There has been a greatly increased tendency, since the end of World War II, for some of the new Engineers to try, in everything they write or do, to "parrot" someone who has been in exactly the same position before them. Unfortunately, many of the men are afraid to go one step forward and use their own ideas and imagination to develop their own logical solution. Thinking of two people who work side by side, that I know of, I see a very interesting contrast. One man, Mr. X (for want of a better name), is a very happy man when he can take any problem that comes to his desk, and by looking at suitable reference books, find a case which he can "site adapt to his problem". The other man, Mr. Y, takes the problems that come to his desk and if he finds a problem that falls into a standard category, carries out the assignment with a lack of enthusiasm. Should a problem reach his desk, that has no standard category to fall into, he immediately comes to life and smiles, digs into fundamental mechanics and the basic theory of materials, and "goes to town".

The percentage of men that are like Mr. Y vary from office to office. Some firms, those which are most progressive, have a high percentage of Mr. Ys in the organization. These are the firms that receive the really challenging engineering problems. A man does not become a real Engineer, like Mr. Y overnight. In addition to having native intelligence and ability to create ideas, he must go through a long training of apprenticeship which lasts for many years after he has finished his formal schooling. These apprenticeship years are both the most trying time for the Engineer and the most fruitful period, as far as his own training is concerned. The men who have the patience to spend the years involved so as to learn the basic fundamentals of whatever their specialty may be, in the long run, come out far better than the men who try simply to be handbook designers.

STEPHEN D. TEETOR '43
President

ALUMNI ENGINEERS

Edited by
J. F. Thomas, ME '63

Stephen M. Jenks, M.E. '23, has succeeded to the position of executive vice-president in charge of engineering and research of the United States Steel Corp. Mr. Jenks began his career at U. S. Steel two years after his graduation. Last year he became administrative vice-president in charge of central operations.

Mr. Jenks' appointment to head the engineering and research department was announced last May 6.

Among Mr. Jenks' positions in the corporation have been those of chief engineer, assistant general superintendent, and general superintendent of the Gary Steel Works; chief engineer of the construction division, manager of Chicago district operations and vice-president in charge of operations of Carnegie-Illinois; vice-president of manufacturing of the old United States Steel Company; and assistant executive vice-president in charge of operations of the corporation.

The Fairless Award of the American Institute of Mining and Metallurgical Engineers was presented to Mr. Jenks in 1956 "for distinguished achievement in iron and steel production and ferrous metallurgy." In 1958, he was a member of the steel delegation from the United States to the Soviet Union.

Pierce G. Fredericks, C.E. '12, has retired as commercial vice president of Federal Pacific Electric Co. He is a veteran of almost half a century in the electrical industry.

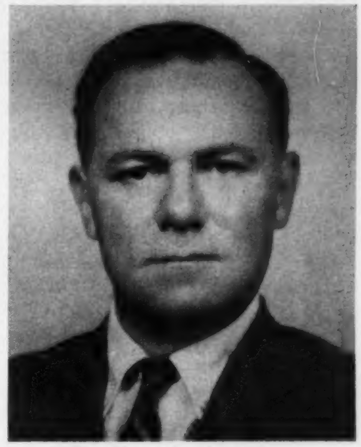
Pierce G. Fredericks

Mr. Fredericks became associated with Pacific Electric Manufacturing Co. in 1937, eventually becoming their switch-gear sales head on the Eastern Seaboard. In 1954, that firm merged with Federal Electric Products Co. of Newark, N.J., to form Federal Pacific Electric Co. The board of directors of the new company elected Mr. Fredericks commercial vice president in charge of high-voltage switchgear sales in the East.

Mr. Fredericks' electrical career began in 1912 when, upon graduation, he joined the J. G. White Engineering Co. as a construction engineer. In subsequent years, he worked as a construction engineer and superintendent for both the Foundation Co. and the Associated Electric Co. of New York City and for New Jersey's Public Service Electric and Gas Co. In World War I, he served as a captain in the Construction Division of the U.S. Quartermaster Corps.

William D. Graham, Jr.

Mr. Fredericks is a member of the American Institute of Electrical Engineers and the Cornell Society of Engineers. Utility and engineering firms that have tendered testimonial luncheons to Mr. Fredericks on his retirement include the American Electric Power Co., Long Island Lighting Co., Ebasco Services, Inc., Gibbs and Hill, Inc., and Burns and Roet, Inc.



Donald A. Booth

Donald A. Booth, C.E. '35, has been appointed engineering manager for the engineering works division of Dravo Corporation, Pittsburgh. He had been assistant engineering manager for the past year. His duties will include supervising the design and engineering of towboats, barges, ore and coal bridges and unloaders, sintering machines and coolers, industrial space heaters, vibrating screens, feeders and conveyors, mixing and pelletizing equipment, metal grating and stair treads, steel shipping containers, and other types of specialized machinery and process equipment manufactured by the engineering works division.

Mr. Booth joined Dravo as an engineer in 1935, shortly after his graduation from Cornell. His experience with Dravo has included field engineering, costs, plant and industrial engineering, and a number of supervisory positions.

After several years as general mechanical superintendent of the engineering works division, he was named chief draftsman in 1956.

Mr. Booth is a member of the American Society of Civil Engineers, the Society of Naval Architects and Marine Engineers, and two honorary engineering fraternities, Tau Beta Pi and Chi Epsilon.

William D. Graham Jr., M.E. '42, has been promoted to vice president, sales office, it was announced today by the Trane Company, La

Crosse, Wisconsin. In his new capacity, Mr. Graham will be in charge of all Trane sales offices in the United States.

Mr. Graham joined the Trane Company in 1946 and attended the firm's specialized training program for graduate engineers. He has since managed the Trane sales office in Greensboro, N.C. He was manager, eastern sales region, before his appointment to vice president.

Thomas Criswell, E.E. '57, an employee of the Hughes Aircraft Company living at Cynwyd, Pa., has been named winner of a Hughes Master of Science Fellowship. Mr. Criswell, who will take graduate work at the University of Southern California, is one of twenty-four outstanding engineering and physics graduates to win a Hughes Fellowship for two-year advanced study beginning with the 1959 spring term. Hughes Fellows work full-time during summer months and twenty-six hours weekly during the academic year in salaried jobs which are closely related to their studies and are near the universities they attend. Since the Hughes program was originated in 1952, more than four hundred have received master's degrees.

Hughes designs and manufactures electronic equipment for civilian and military use, including armament control systems for U.S. Air Force all-weather jet interceptors, Falcon air-to-air guided missiles, radar ground systems, and commercial products such as cathode ray storage tubes, semiconductor devices and electronic controls for machine tool lines.

Thorp Sawyer, C.E. '14, has opened an office in Tucson, Arizona, as a consulting engineer, specializing in mining and water projects, appraisals, and operations. In 1956, Mr. Sawyer was in Grass Valley, California, as manager of the Nevada Irrigation District, after thirty years of mining south of the Rio Grande.

Albert P. Craig, Jr., E.E. '26, is vice-president of sales and public relations for Trans-Canada Pipe Lines, Ltd. In 1954, after twenty-seven years with Westinghouse Electric Corp. in the United States

Alumni News

Albert P. Craig, Jr.

and Canada, he resigned as vice-president of Canadian Westinghouse to help organize and develop Trans-Canada Pipe Lines to transmit natural gas from Western Canada to markets in Eastern Canada. The 2300-mile, 30- and 40-in. pressure line costing $375 million was finished in October, 1958.

William L. Everitt, E.E. '21, dean of the College of Engineering at University of Illinois, was one of eight outstanding American engineering educators who spent a month in Russia last fall studying their engineering education. Dean Everitt joined the University of Illinois in 1944 and became dean of the Engineering College in 1949.

Dean Everitt is considered one of America's foremost authorities in electronics. He has been president of the Institute of Radio Engineers and the American Society for Engineering Education and was recently elected president of the Engineers Council for Professional Development, a nation-wide organization of eight major professional engineering societies.

Abraham Hertzberg, M.S. in Aero. E. '49, assistant head of the Aerodynamic Research Department at Cornell Aeronautical Laboratory, has been selected as a member of the Research Advisory Committee on Fluid Mechanics for the National Aeronautics and Space Administration (NASA).

The committee has been established to review the work in progress by the NASA in the field of fluid mechanics and to propose new areas of research. They also will assist the NASA in the maintenance of communication and coordination with scientific, industrial, and governmental organizations.

Mr. Hertzberg received a B.S. in Aero.E. from Virginia Polytechnic Institute in 1943 and his M.S. from Cornell. He served as an aerodynamicist with Curtiss-Wright Corp., in 1943-44 and as a flight test engineer with the U.S. Army in 1944-45. Mr. Hertzberg joined CAL in 1949 as a research aerodynamicist, and was promoted to section head in 1950 and to assistant head of the Aerodynamics Department in 1951. He also is a member of several professional engineering societies.

Bartholomew J. Viviano, M.E. '33, has been elected vice president in charge of traffic of the Lehigh Valley Railroad Company, New York City. He joined the railroad in 1946 and has been vice president and general counsel since 1955. At National Football Foundation and the first annual award dinner of the Hall of Fame, October 28, in New York City, Mr. Viviano and thirteen other grid greats were honored as having made contributions to business, science, and education in postgraduate life. Mr. Viviano lives in Plainfield, New Jersey.

Hunter L. McDowell, E.E. '48, is presently associated with the Bell Telephone Laboratories working on the development of vacuum tubes, especially traveling-wave tubes. He recently presented a paper at the annual convention of the Institute of Radio Engineers Professional Group on Electron Devices. The paper concerned a 55,000 megacycle traveling-wave tube developed by Mr. McDowell and his associates.

Lt. Col. Albro L. Parsons Jr., M.C.E. '47 of the Army Corps of Engineers has been assigned to duty with the Corps' Eastern Ocean District. He will serve as area engineer at Lajes, Azores, supervising Corps of Engineers' construction for the Navy and the Air Force in the Azores. Announcement of his assignment was made by Col. Carlin H. Whitesell, district engineer,

at his headquarters in New York City.

Colonel Parsons is a graduate of Pennsylvania State University, having received his Bachelor of Science degree in civil engineering in 1941. In 1946 he entered Cornell University for graduate study, receiving his masters degree in engineering in 1947. He is also a graduate of the Army's Command and General Staff College.

He is a member of the Society of American Military Engineers, the American Society of Civil Engineers, and the Kentucky Society of Professional Engineers. He is also a member of Tau Beta Pi, Sigma Tau, and Chi Epsilon engineering honor societies; Phi Delta Theta social fraternity; and Scabbard and Blade.

Walter L. Cisler, M.E. '22, has been elected head of the 50,000 member American Society of Mechanical Engineers. He and the other new officers will be installed at the Society's annual meeting this December in Atlantic City.

Mr. Cisler is president of the Detroit Edison Company and has been very active in furthering the use of atomic energy as a source of power. He has served as executive secretary of the Atomic Energy Commission Industrial Advisory Group. He has also served as president of Power Development Associates, Inc.; of the Fund for Peaceful Atomic Development, Inc.; and of the Power Reactor Development Company. He is presently the United States member of the Energy Advisory Commission of the Organization for European Economic Cooperation.

Mr. Cisler is a trustee of Cornell University and a past-president of the Cornell Society of Engineers.

Edmund M. Mackert, Chem.E '57 has been promoted to assistant chemical engineer in the technical division at Humble Oil and Refining Company's Baytown, Texas, refinery. In the catalytic cracking section he is responsible for the technological control of the operation of the refinery's catalyst cracking unit no. 3. He also engages in studies related to maintaining maximum efficiency of operation of the unit and the process design of modifications to the equipment. Mr. Mackert is a member of American Institute of Chemical Engineers.

COLLEGE NEWS

Edited by A. Speare, Jr., EP '63

1959 GRADUATES HIT PAY DIRT IN JOB PLACEMENT

Last June's engineering graduates were successful in finding well-paying jobs in their fields of choice. A study of the salaries being received by these students shows that the average is $530 a month. The lowest salary reported was $420 a month while the highest was $640.

A total of 272 students graduated from the College of Engineering last year. Of these, 124 have reported that they have received jobs in the field of their choice, seventy-four have gone on to graduate schools, and six are in foreign work. Approximately sixty students were commissioned as officers in the United States armed forces and twenty-eight are presently serving active duty.

Graduates in engineering physics received the highest salaries with an average of $570 and an individual high of $640. The chemical engineers received an average monthly wage of $543 and the individual high was $600. Metallurgical engineers averaged $539 and were closely followed by the electrical engineers who received $538.

Agricultural engineers averaged $527; mechanical engineers, $526; and civil engineers, $486.

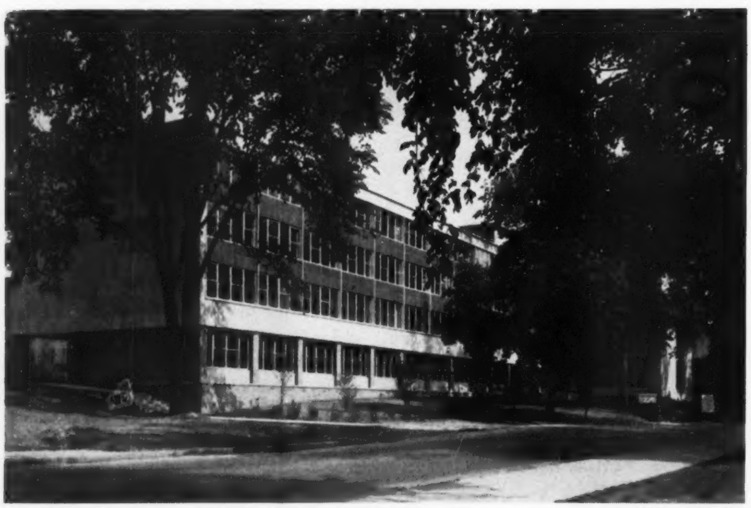
These salaries show a $20 increase over the average salaries of 1958 graduates, who received a mean of $510. The salary of the average 1950 graduate was $270 a month.

CIVIL ENGINEERING BUILDING, HOLLISTER HALL, DEDICATED

On October 16, 1959, Hollister Hall, the new civil engineering building was officially dedicated. The ceremony was a part of the Alumni Homecoming Week program.

The building was donated by Spencer T. Olin, M.E. '21, in memory of his father, Franklin W. Olin, of the class of 1886. Franklin Olin was the donor of the first building of the engineering quadrangle, Olin Hall. The new civil engineering building was named in honor of Solomon Cady Hollister, dean of the College of Engineering from 1937 until his retirement last June.

At the dedication ceremony, Mr. Olin officially presented the building to the University. He stated that since it was largely through Dean Hollister's efforts in securing support from alumni that the engineering quadrangle reached completion, it was fitting that the new civil engineering building be named in his honor. Hollister Hall was accepted for the University by Deane W. Malott. President Malott also announced that Mr. Olin had agreed to donate an additional $500,000 for the equipping of the building. Peer Ghent, CE '61, and the dean of the College of Engineering, Dale R. Corson, then expressed the gratitude of the students, faculty, and administration of the College of Engineering for Mr. Olin's gift. In his speech, Professor Hollister thanked the alumni for their gifts which made the completion of the quadrangle possible.



Fenner Studio

Hollister Hall, Cornell's new civil engineering building, was dedicated in October. The $2,000,000 building completes the engineering quadrangle planned by S. C. Hollister, former dean of the College of Engineering, almost twenty years ago.

Hollister Hall, a $2,000,000 five-floor structure, contains about 110,000 sq ft of floor space. One wing of the building contains classrooms and faculty offices while the other houses laboratories and other facilities for research. A large laboratory is provided for work in hydraulics and fluid mechanics. There is a transportation laboratory for instruction and research in highway and airport design. The building contains extensive facilities for studies in sanitary engineering as well as special laboratories and plotting rooms for instruction in new aerial photogrammetric procedures used in surveying. Laboratories for studies in soil mechanics and structures research are also provided. Hollister Hall has a large lecture room with a seating capacity of 220. The building is equipped with desk and office space for all fifth-year and graduate students.

NUCLEAR REACTOR CENTER TO BE BUILT AT CORNELL

The Cornell campus will soon house a nuclear reactor which, according to Dean Corson, "will afford the most comprehensive and flexible arrangement yet devised for the teaching of reactor science and engineering."

The new nuclear reactor will be part of a center to be located on the Cascadilla gorge directly behind Kimball-Thurston and Upson Halls. The reactor itself will be housed in a large cube-shaped section, but the center will also contain two stories and a basement filled with supporting equipment, offices and laboratories.

The project will cost approximately $1,550,000 with a National Science Foundation grant of $475,000 paying for a large share of it. Professor T. R. Cuykendall and Assistant Professor David D. Clark, both of the department of engineering physics, will direct the project.

The nuclear unit will contain a zero-power core for research, and a training core called TRIGA (Training Research Isotope General Atomics). The zero-power research core will be used to study the basic mechanism of a reaction and to examine the interaction between neutrons and their surroundings. The device will also have a flexible design for studying reactors themselves.

The training core, TRIGA, will give students an opportunity to gain first-hand experience in nuclear processes. Qualified undergraduates as well as graduate students will have an opportunity to work with the reactors.

The reactor will be completely safe. Its core will be located at the bottom of a 25-ft pool of water which will completely eliminate the danger of radiation.

The designs, which were drawn up by Vitro Engineering Co., were on display in Carpenter Hall during October. As planned, the center should be completed by June, 1961.

GLENNAN LECTURES ON NASA SPACE PROJECTS

Dr. T. Keith Glennan, head of the National Aeronautics and Space Administration, recently delivered a lecture at Bailey Hall entitled, "The Coming Space Age, Problems and Prospects."

Project Mercury, the man-in-space program, is, according to Dr. Glennan, currently the most important NASA project. The object will be to launch a manned 2000-lb. capsule into an orbit around the earth at an altitude of about 110 miles. The capsule is to make several revolutions before reentering the atmosphere. A man will then have been in outer space about 4½ hr. Dr. Glennan explained that there will be twenty-two tests before the attempt to launch the manned satellite. Several IRBM's and ICBM's will be launched and caught as practice maneuvers and the Astronauts will ride in Redstone IRBM's in their training exercises. Dr. Glennan stated that over a quarter of a billion dollars will be spent on the project before the manned satellite will actually be put into space.

Lunar exploration is another of the goals of the Administration. Dr. Glennan stated that they would like to put satellites in orbit around the moon and eventually attempt a controlled landing. The ultimate step will, of course, be that of putting a man on the moon and then returning him to earth, but Dr. Glennan asserted that such an attempt is not likely within the next ten years.

At present, our largest rockets develop a thrust of about 360,000 lb. A quarter of a billion dollars is to be spent on the development of a rocket with a thrust of 1,500,000 lb. Dr. Glennan stated that a rocket capable of carrying a man to the moon and back would need about 9,000,000 lb. thrust.

In explaining the competition between the United States and Russia, Dr. Glennan asserted that Russia has succeeded in making the world look upon her successes in rocketry as a measure of the success of her culture. It is his opinion that since the United States has always been the most progressive of nations scientifically and technologically, it can do nothing but accept the Soviet challenge.

But Dr. Glennan described the Soviet program as one aimed primarily at making spectacular "shots" for propaganda purposes. Although he felt that the Soviets must not go unchallenged, he also maintained that it is not necessary for the United States to challenge them directly on their own ground. The U.S. program, he said, is not aimed at making spectacular shots. It is one of long-range planning toward specific goals. Dr. Glennan asserted that some spectacular shots will come as natural by-products of the program but that they are not the primary aim of the development work.

EXCHANGE TO SEND EASTMAN TO SWEDEN, OLVING TO CORNELL

Photo Science

Associate Professor L. F. Eastman of the School of Electrical Engineering is to visit Sweden on an exchange program while Professor Sven Olving of Chalmers Technical University is coming to Cornell.

Cornell has agreed upon a one-year exchange of professors with the Chalmers Technical University of Gothenburg, Sweden. Starting in February 1960, Associate Professor Lester F. Eastman of the School of Electrical Engineering will travel to Sweden and Associate Professor Sven Olving of the E.E. School at Chalmers will come to Cornell. Both men have been working on microwave electronics and they will take over each other's work in hope of gaining added experience by the change in environment.

Professor Eastman is a Cornell graduate with a B.E.E. in 1953 and a Ph.D. in 1957. In the last two years he has been teaching courses in microwave electronics and transistors and has done research in microwave tube theory and maser theory.

Sven Olving has also been teaching advanced microwave electronics and microwave atomics at Chalmers and has been doing research on electron beam microwave dynamics, which is similar to the research Professor Eastman has been doing.

DEAN'S HONOR LIST

School of Chemical and Metallurgical Engineering

Matthew E. Oren, Donald Potter Keel, Jr., Donald Goldfarb, Allan Clark Berg, Stephen Lloyd Garrell, Kenneth Alan Collins, Eugene LaRowe, Stephen Allison Wald, Michael Neale, Edward John Kramer, Paul Prescott Morrison, Henry Olin, Walter Collins Gates, Charles Augustus Gray, Steven George Paradis, Peter Reeves Sperry, Max Curtis Deibert, Allan Paul Miller, Don-

ald Edward Buzzelli, Dean Edward Danzer, Harvey Lester Fein, Robert Wayne Hendricks, David Lawrence Ripps, Donald Eugene Sweeney.

School of Civil Engineering

John Frederick Abel, Eilif Magnus Brodtkorb, Joseph David Dreyfuss II, Stuart Charles Edelberg, David Smith Fuss, Christopher Gale, David Franklin Harrald, Carl Bauman Loutzenheiser, Michael Joseph Meyer, Donald Guy Armstrong, Lawrence Santucci, Jr., Paul Michael Teicholz.

School of Electrical Engineering

Ira A. Abramowitz, George E. Beine, David A. Berkley, Don J. Blumenthal, John F. Burns, Randall K. Cole, Jr., James B. Comly, John N. DeRis, Nesat Erdibil, Barry I. Feinblatt, Donald E. Felker, Richard F. Fellows, Jeffrey I. Frey, David P. Friedley, Peter Y. Hanna, Carl E. Heiles, Lewis M. Holmes, Joel S. Jayson, David Jordan, Vahe Keshish, Bruce Klipec, Arthur R. Kraemer, Harold E. Kunsch, Benjamin E. Lipschuetz, Robert J. Loane, David L. Losee, Ronald J. Lutz, Albert R. Martin III, Hugh S. Martin, Clyde A. Miller, Donald C. Mitchell, Peter H. Mitchell, John L. Neuman, Thomas A. Osborn, William Quakenbush, James H. Ransom, Peter D. Sofman, Enn Tammaru, Paul D. Thompson, James S. Thorp, Donald C. Uber, Peter S. Warwick, Ray A. Westendorp, William M. Wichman, John E. Winter, David Wunsch.

ARC WELDING FOUNDATION ANNOUNCES SCHOLARSHIPS

The $5,000 in annual awards made by The James F. Lincoln Arc Welding Foundation in its design competition for college engineering undergraduates this year went to sixty-six students from twenty-one colleges and universities. The first award of $1,250 went to Seppo J. Viikinsalo of the University of Minnesota and the second and third awards went to students from the University of Illinois and New York University.

Cornell CE's Rodney Carpenter and Lawrence E. Santucci, Jr. won a $75 fourth award in the structures division of the contest while four more CE's, Irving Abramowitz, Mesfin Leikun, Lucas Vicens, and Louis J. Porcello, won a fifth award for their entry in the same division. In addition, William S. Carpenter, a Cornell ME, won a fourth award in the mechanical division.

The foundation has announced a similar undergraduate design competition for the current school year. All undergraduate students in all branches of engineering are eligible to participate. A rules booklet is available from The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

CAL TO BUILD WIND TUNNEL FOR LONG-DURATION MISSILE TESTS

Cornell Aeronautical Laboratory is planning to build the world's first wind tunnel for long-duration testing of hypersonic missiles and space vehicles under actual atmospheric flight conditions.

CAL's tunnel is expected to supply the same data that can now be gotten only by full-scale, free-flight tests. These tests should yield important information on the severe heat conditions caused by air friction at hypersonic speeds.

The tunnel's combination of high-speed, high-temperature airflow with relatively long test durations will make it the first experimental facility able to simulate exactly hypersonic flight in the earth's atmosphere for a realistic time period. The new installation, called a "wave superheater hypersonic tunnel," will generate airflows around 10,000 mph and temperatures of 9,000 F. It will be able to operate for periods of 15 seconds, as compared to the present devices which can produce these conditions for only a few thousandths of a second.

The new wind tunnel will be built at Buffalo under a 3-1 million dollar contract from the Air Force Air Research and Development Command. CAL has already been working on the wave superheater which will supply the high-velocity, high temperature air for the new tunnel.

CAL President Ira G. Ross says the new wind tunnel should be ready for operation in two years.

BARD DONATES METALLURGICAL ENGINEERING BUILDING

A new metallurgical engineering building will complete the Cornell University engineering quadrangle. Mr. Francis N. Bard, member of the Cornell University Council and president of Barco Manufacturing Company, has donated the $1,500,000 building.

Mr. Bard has already benefited Cornell's metallurgical engineering program by establishing the Francis Norwood Bard chair in metallurgical engineering in 1947. The holders of the chair are selected on the basis of industrial experience and academic standing. The present chair holder, Professor George V. Smith, had these comments, "Modern technology is making greater demands upon metallurgical engineering than ever before—demands which must be met if this nation's position as the foremost scientific power of the world is to be maintained. There is a twofold need for greater knowledge in metallurgical engineering and for young men who have been prepared for roles of responsibility and leadership in this vitally important field. Mr. Bard's splendid gift (of the building) gives recognition of this and will enable Cornell to further improve and strengthen its program in metallurgical engineering."

Cornell granted Mr. Bard the M.E. degree in 1904. He received his interest in metallurgical engineering from his father, who was the first to use natural gas to heat steel. Together, they bought a company now called the Barco Company, which manufactures ball joints used in the transmission of fluids and gases. Mr. Bard was director of the National Association of Manufacturers for eleven years and is also a rancher, farmer, and big game hunter.

CORNELL ENGINEER SCHOLARSHIP AWARDED TO CHEM E STUDENT

The Cornell Engineer announces that its annual scholarship has been awarded to Theodore F. Swift, Chem E '63, for the academic year 1959 to 1960.

The scholarship of $150 is awarded annually to an engineering student who has completed his second or third term, ranks in the top half of his class, and has shown interest in extracurricular activities. After these qualifications have been met, the University Scholarship Committee awards the scholarship on the basis of financial need.

Mr. Swift now stands 30 in a class of 114 sophomore chemical engineers and was one of a few freshmen who were active in the American Institute of Chemical Engineers last year. He also was an active member of the Cornell Corinthian Yacht Club.

Each year a different school is connected with the scholarship through a predetermined cycle. Next year the scholarship will go to a mechanical engineering student and in 1961–1962 it will go to an electrical engineer. The choice of recipient is made either by the University Scholarship Committee or by a scholarship committee connected with the school concerned.

GRAD ARCH STUDENTS TO PLAN NUCLEAR SURVIVAL MEASURES

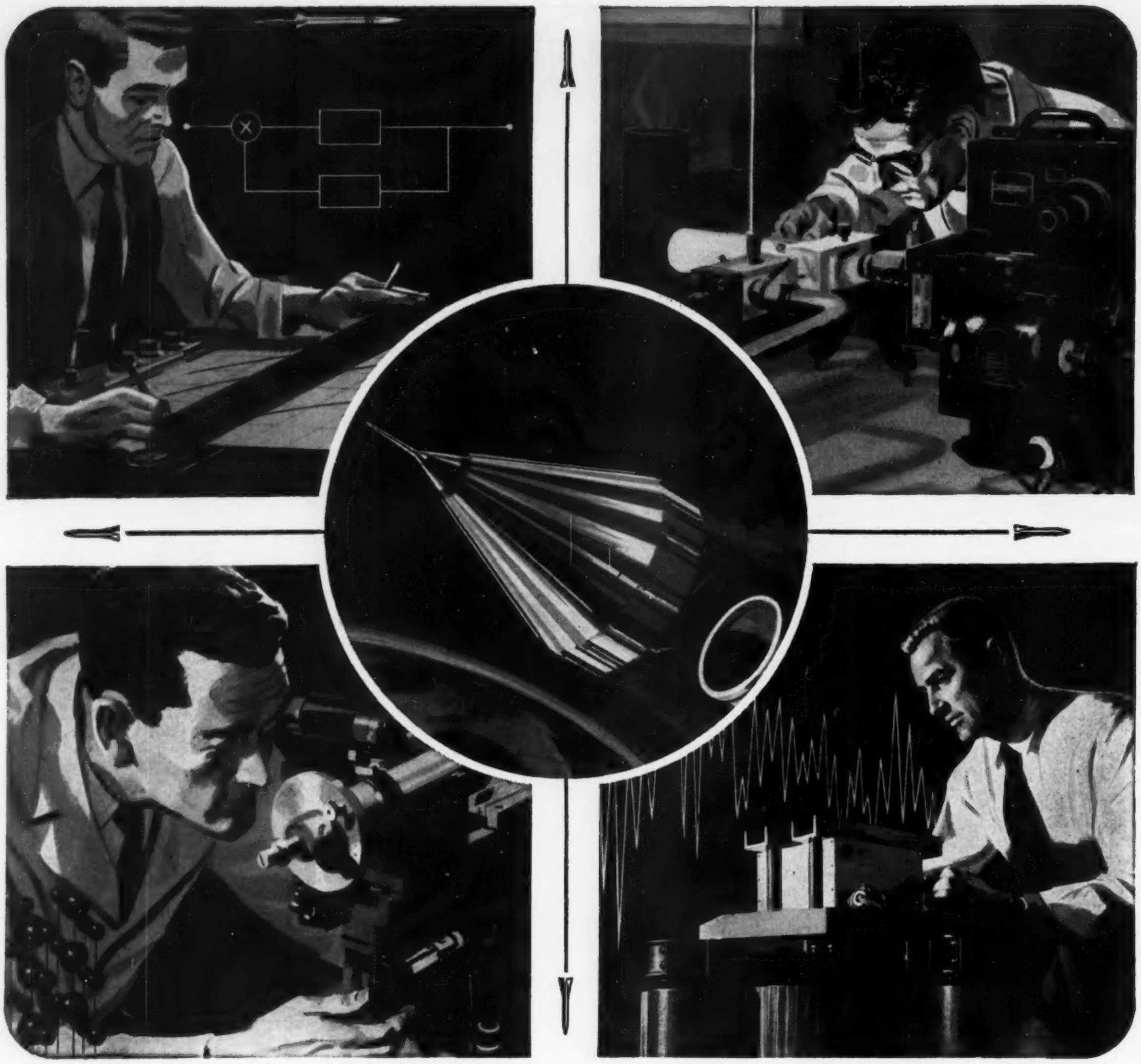
Cornell graduate architecture students in the department of city and regional planning are conducting a study this term to determine what a new industrial community could do to protect itself from the effects of nuclear warfare.

The study is exploring the various measures a critical industry might take to insure its continued operation in the event of a full scale nuclear, biological, and chemical war. One of the measures being considered is the feasibility of placing a vital wartime industry underground.

Approximately thirty graduate architects and planners will undertake the study under the supervision of Professor Frederick W. Edmondson. The New York Civil Defense Commission, the U.S. Office of Civil and Defense Mobilization, and the New York State Dept. of Commerce are participating in the program along with private industries, the American Machine and Foundry Co., the Buffalo Forge Co., and the I. B. M. Corp.

The group is thinking of survival under the effects of 20-megaton bombs which are expected to cause complete destruction within a 25-mile radius. They are also taking into consideration the effects of biological and chemical weapons which the enemy might use.

Problems facing the group include the selection of a site for a community which will be outside present target areas, offer the availability of employees and be suitable for development.



YOUR TASK FOR THE FUTURE

Since its inception nearly 23 years ago, the Jet Propulsion Laboratory has given the free world its first tactical guided missile system, its first earth satellite, and its first lunar probe.

In the future, under the direction of the National Aeronautics and Space Administration, pioneering on the space frontier will advance at an accelerated rate.

The preliminary instrument explorations that have already been made only seem to define how much there is yet to be learned. During the next few years, payloads will become larger, trajectories will become more precise, and distances covered will become greater. Inspections will be made of the moon and the planets and of the vast distances of interplanetary space; hard and soft landings will be made in preparation for the time when man at last sets foot on new worlds.

In this program, the task of JPL is to gather new information for a better understanding of the World and Universe.

"We do these things because of the unquenchable curiosity of Man. The scientist is continually asking himself questions and then setting out to find the answers. In the course of getting these answers, he has provided practical benefits to man that have sometimes surprised even the scientist.

"Who can tell what we will find when we get to the planets? Who, at this present time, can predict what potential benefits to man exist in this enterprise? No one can say with any accuracy what we will find as we fly farther away from the earth, first with instruments, then with man. It seems to me that we are obligated to do these things, as human beings."

DR. W. H. PICKERING, *Director, JPL*

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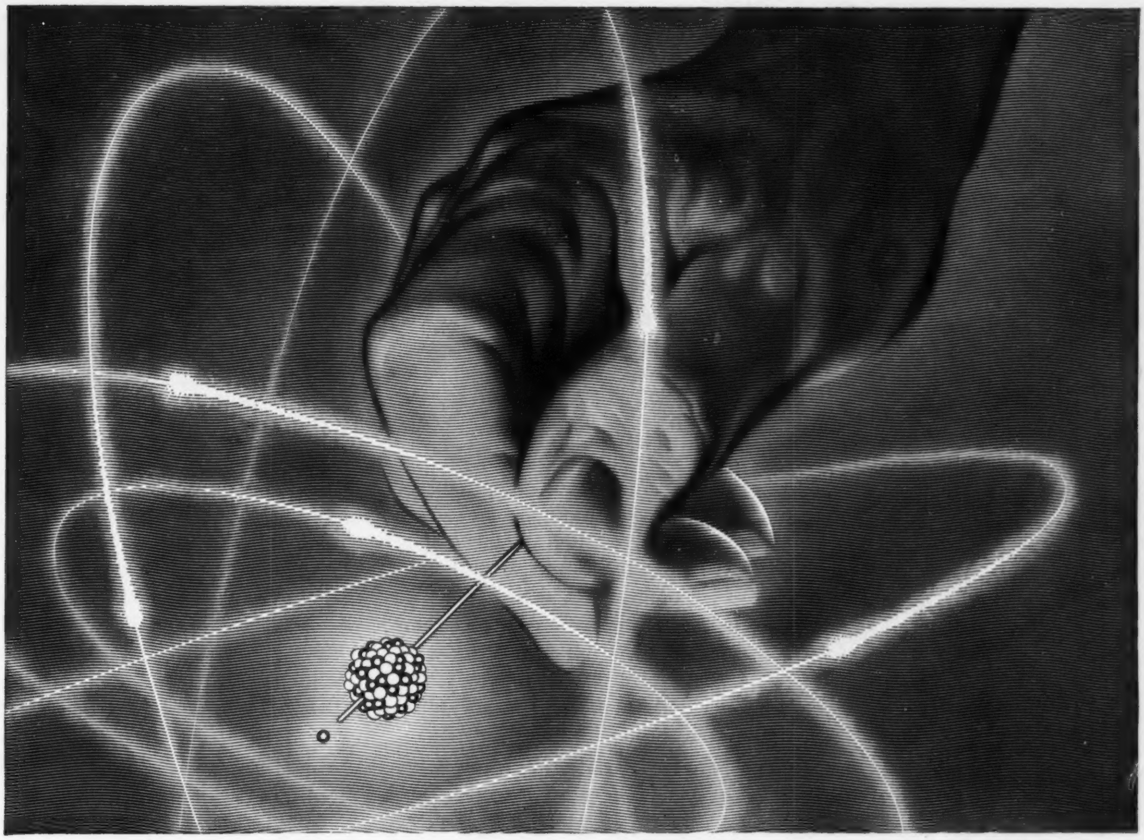

... a hand in things to come

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The boundless energy of the uranium atom means a brighter future

Every day brings the benefits of atomic energy closer to our daily living. It presents a whole new field of exploration for scientists all over the world.

A longer, healthier life is hopefully ahead as radiation is helping doctors learn more about the basic processes of life by revealing how certain elements are put to work by the body. The controlled rays of the atom are also being used to pin-point malignant tissues for subsequent treatment. And radiation studies of how plants absorb nutrition from sun and soil are showing the way to improved food supplies.

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UNION CARBIDE

...a hand
in things to come

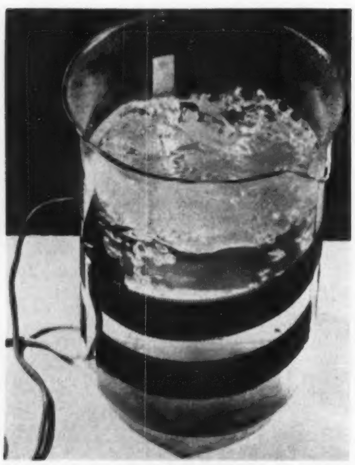
TECHNIBRIEFS

GRAPHITE NOW PRODUCED IN FLEXIBLE TEXTILE FORM

Manufactured graphite, used in many industrial and military applications, is now being produced in flexible fiber and fabric form. National Carbon Company has developed a revolutionary process to convert organic textile forms directly to graphite of more than 99.9 per cent purity.

Any textile form can be produced in this unique material. In the complex production process, a fiber or fabric such as rayon is graphitized by electric heating to almost 5,400 F. In this thermo-chemical conversion, the crystalline structure of the material is changed to that of graphite in the form used for electric furnace electrodes, nuclear reactor structures, metallurgical molds, and many other industrial processes.

Graphite has a unique combination of electrical, chemical, and mechanical properties. At ordinary pressures, graphite has no melting point and sublimes at extremely high temperatures. It has the unusual property of getting stronger at higher temperatures, and its tensile strength at 4,500 F. is about twice that at room temperature. Graphite oxidizes in air at temperatures in excess of 750 F.



National Carbon Company

A one-inch strip of graphite cloth forty inches long is wrapped around a beaker of water to illustrate the resistance-heating properties of the unique new material in applying heat exactly where it is wanted. The 700 wave demonstration unit brings water quickly to a vigorous boil when connected to a 110 volt circuit.

Graphite textiles are resistant to attack by most acids, alkalies, and organic compound except strong oxidizing agents and are unreactive with many molten metals. They have excellent electrical and thermal conductivity, and being in flexible form, are immune to thermal shock. Graphite also has well-known lubricating properties that extend its high-temperature applications even further.

The combinations of properties and available forms make applications of graphite textiles almost unlimited. Graphite is used as a reinforcing agent for various plastics and refractory materials used at high temperatures. Its fibers and fabrics can be used to impart electrical and thermal conductivity to non-conducting materials such as plastics or ceramics and even to other textile materials such as glass cloth.

CAMERA RECORDS EXPLOSION IMPULSE EFFECTS ON METALS

An accurate and easy method of measuring and recording transient elastic waves created in metals by impacts and explosions has been developed at the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia.

Simple in comparison with complicated and undependable methods used in the past, the new system gives research engineers a means of studying the patterns of shock waves and their speed of transmission in solid materials. This data helps the Army Engineers establish design criteria to minimize the effects of explosive shock on military equipment. The test method is expected to enable them to predict more accurately the effects on finished equipment of impulses caused by explosions or bullets.

An explosion set off at one end of a metal bar to which a strain gauge has been attached sends a shock wave down the bar at tremendous speed. The strain gauge picks off a reading from the shock wave and transmits a signal to amplifiers. These display a reading on the calibrated face of an oscilloscope in the form of a pip of light.

A Polaroid camera with shutter opened is prefocused on the face of the oscilloscope and records the pip in the form of a line as it passes. The curve of the pip of light indicates the speed of propagation of the shock wave, the shape and changes of the wave, and the duration of strains. The oscilloscope is set for a four microsecond sweep to reproduce a detailed display of the signal picked up by the strain gauge.

CRYSTAL GROWING PROCESS INCREASES EFFICIENCY

Scientists at Westinghouse Laboratories have devised a revolutionary new method of "growing" germanium crystals as thin, uniform, flat ribbons instead of round ingots.

In the new technique, the semiconductor is grown in the exact form in which it is to be used in a transistor or similar device. Further development of the technique could yield a machine that could turn out finished transistors continuously and automatically from raw germanium and other necessary materials.

Tremendous waste is incurred in the conventional procedure of slicing thin wafers of germanium from large ingots. After all of the cutting

and polishing is over, 80 per cent of the germanium has been lost.

Dendritic germanium, on the other hand, would be of the proper thickness for direct use and its ultra-smooth surfaces would need no grinding. Thus, the expensive and wasteful processing would be eliminated.

NUCLEAR EXPLORER ACCELERATES PARTICLES NEAR LIGHT SPEED

A linear electron accelerator two miles long has been proposed for construction at Stanford University. If constructed, the accelerator would give particles the extremely high energies desired in experimentation in nuclear physics.

The accelerator consists of a metal tube 4 in. in diameter which contains metal discs spaced about 1 in. apart, each with a hole of 1-in. diameter. Electromagnetic waves are fed in at ten-foot intervals along the tube. Klystrons used in high-power radar systems supply this power to the accelerator. The electromagnetic field is arranged to push the electrons continually in one direction. The electrons increase in speed and energy until they are traveling at almost the speed of light. The high energy is very important since it makes possible the observation of finer detail and the production of a greater variety of changes in matter.

In experiments of this type, the high-energy electron delivers a tremendous "punch" to target material. Part of this energy goes into breaking up the nucleus, and part of it is converted into new forms of matter such as mesons, hyperons, and anti-nucleons. These particles usually do not last very long, but while they survive they make fascinating objects of study.

The plans call for a tunnel for the accelerator, or a deep trench that can be covered over. The klystrons would be located in a parallel tunnel far enough away so that the intervening earth would provide sufficient shielding to protect the people working there. The electromagnetic power would be fed from the klystrons to the accelerator by pipes running between the tunnels.

If construction of the accelerator is carried out, it is estimated that it would be operating at one-third of its maximum energy after five years, and fully completed after seven years. It would give the electrons about forty-five billion electron volts. The most powerful existing accelerator is a ten billion-electron volt proton machine in the Soviet Union.

NEW TAPE RECORDERS USED FOR SATELLITE COMMUNICATIONS

Tape recorders whizzing through outer space are opening man's eyes to new uses for magnetic recording tape. The next decade promises to unfold space-age extensions of present day distance measure and computer and flight testing, uses undreamed of in 1948 when tape recording first became practicable on a consumer scale.

One satellite, shot into orbit by a Vanguard rocket, features a tiny tape recorder which relays by means of magnetic recording tape a global picture of the world's weather.

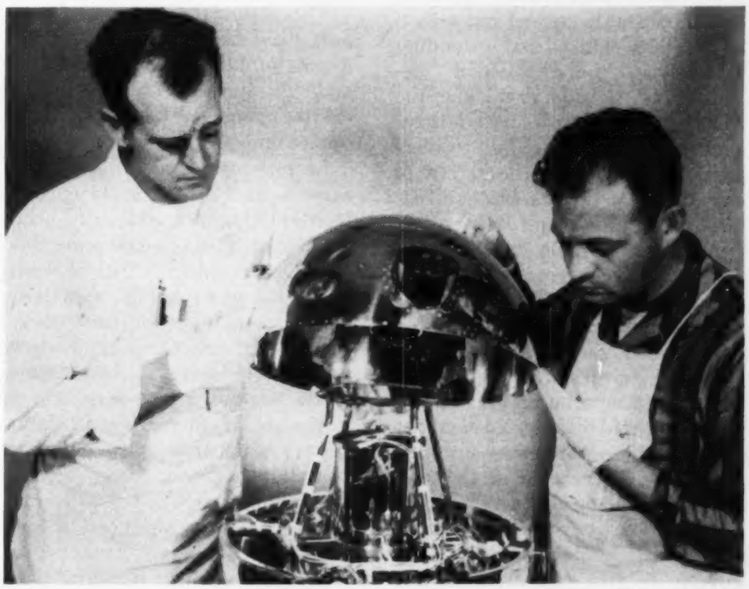
Another disc-shaped recorder features an endless-tape cartridge containing 75 ft. of magnetic tape which will supply four minutes of recording while the satellite is in range of the ground equipment. The cartridge functions by unwinding the tape from the inner wrap and winding it up on the outer wrap of a 2-in. wide supply spool.

Used commercially for five years in advertising, background music, and transportation terminal announcements, the endless loop cartridge is considered desirable for satellite recorders because it eliminates the need for rewind, thus requiring a less complicated mechanical structure.

Recently, an Atlas rocket was launched containing a 35-lb. package of transmitting, receiving, and recording equipment designed to receive, store, or relay messages from ground stations. When in range of these stations the orbiting relay received and transmitted seven written messages or one voice message.

To obtain stored messages from the communications relay in the satellite, a ground station triggered off the relay transmitter by electronic command. As long as the satellite courier was in range, the ground station could also transmit its own message for relay to another station. Messages could be relayed from one station to another without storage.

Messages destined for the communications relay in the satellite



U.S. Army Photo

The upper half of a cloud-cover satellite shell is gently lowered into place by technicians at the Astro-Instrumentation Branch of the Army's Signal Research and Development Laboratory, where the satellite's electronic system was designed and built. The weather forecasting experiment depends upon two photocells which scan the earth's surface and cloud masses. Data are stored on instrumentation tape in a recorder which is interrogated every orbit.

were fed to ground stations over standard links. Teletypewriter dispatches and a voice message were transmitted to the satellite courier when it came within range in its pass.

Each of four stations throughout the United States consisted essentially of five standard trucks, in which the communications and other equipment was mounted. The antenna array was a separate unit. Multiplexing equipment at the stations handled up to sixty words a minute on each teletypewriter channel, or a total of 420 words a minute. The recorder in the communications relay could store about 1680 telegraphic words in its four-minute storage capacity.

It is predicted by experts that these successful tests of tape recorders in space may lead to commercial advertising by privately owned satellites, intercontinental television, space air mail service, microwave radio broadcasting, and world-wide weather forecasting.

NEW SPACE RANGE CONSTRUCTED TO TEST SUPERSONIC PLANE

A new space range has been developed and built by the Electronic Engineering Company of California for testing the mile-a-second X-15 research airplane which will fly at one-hundred miles altitude. Completed at a cost of more than two million dollars and extending across four hundred miles of California and Nevada dry lakes, the range provides six hundred thousand answers per second to electronic questions on the safety of the pilot and the condition oi the airplane when it drops from a B-52 bomber and propels itself.

A continuous flow of electronic information is provided by the range so that flight engineers and scientists may observe everything from the heart beat of the pilot to the skin temperature of the airplane. Ground observers at any station along the range may instantly observe the condition of the pilot and the airplane during the flight. Simultaneously, radars and plotting boards pinpoint and trace the course of the research vehicle which is capable of speeds higher than 3,600 miles per hour.

A constant-contact communications system enables the pilot and all three ground stations to be in touch continuously. If the pilot cannot contact one ground station, the other stations can receive his voice and relay it rapidy via telephone line to the other stations. All of the radio transmitters and receivers at all the stations are on the air simultaneously and are interconnected via long-distance telephone line.

Also contained in the test range system is a specially designed radar data recording system which automatically converts radar information into a form which is utilized by the Air Force Flight Test Center automatic data processing system. In about thirty hours, using only two operators, data from a single flight can be fed from the high-range equipment and processed through the datum system, which was also developed by the Electronic Engineering Company. Formerly such a procedure, using photo panel methods and manual data reduction, required more than thirty days and a dozen or more data interpreters. Aeronautical design engineers sometimes had to wait more than a month before being able to make a design decision based on test flight information.

ELECTRONIC DEVICE ALLOWS COMPUTERS TO COMMUNICATE

The National Bureau of Standards has been investigating the logical problems arising when several high-speed electronic computers are connected together to work on a common large-scale task.

In organizing such a network, many logical problems are encountered that do not ordinarily occur in the usual single-computer system. One problem is that of devising an efficient scheme for enabling all the computers to share among themselves, automatically, the total workload undertaken by the network. Another problem is that of designing a machine instruction system which can carry out these complex operations effectively and yet is simple enough to code easily. NBS men have designed a new Pilot Data Processor, a multi-computer network with powerful data-processing capabilities. The Electronic Engineering Company of California has also developed a computer to handle these operations.

Many large-scale data-processing jobs, for which solutions are now urgently required, call for much faster computing capabilities than presently available machines can provide. The resulting demand for computer components of higher basic speed has in many respects exceeded the resources of current component technology. In order to shorten problem-solving times, it became necessary to try to organize these components into more powerful logical combinations for doing the job. One mode of approach is to connect together several computers into an integrated network to let all of the machines in the network work together on large-scale tasks. By dividing the total task into different pieces, and by having all the different computers in the system work on different parts of the task simultaneously, a large increase in the speed of solution can be achieved.

The sequence of events for the most elementary type of system would be as follows: At the beginning, the primary computer initiates a request to the secondary computer. Some time later, the secondary finishes its job, halts, and sends a "job completed" notice back to the primary. At this time, however, the primary may not be at a stage in its program where it wishes to accept the offered data. A delay ensues, during which the primary continues to run while the secondary remains idle, waiting for further orders from the primary. As soon as the primary reaches a suitable point in its program, it issues a "call-back" order to the secondary and then immediately accepts the data that are returned to it. After its results have been accepted, the secondary remains idle until the primary transmits another request to it.

The new NBS Pilot Data Processor contains not only a primary and secondary computer but also a third independent computer, which specializes in operations that control and interpret the data flowing between the system's internal memory and its external storage and display devices. In the future development of these network systems, it is expected that even larger numbers of independent machines will participate cooperatively in the performance of rigid tasks.

SIX PERTINENT QUESTIONS TO ASK THE ALCOA RECRUITER WHEN HE VISITS CORNELL

Here's What You May Want to Ask About Opportunities at Alcoa

1. Where can I go in Alcoa with my type of degree?
2. In what part of the country would I be located?
3. What kinds of training programs will I participate in at Alcoa?
4. What are my starting salary prospects?
5. Will Alcoa pay my moving expenses?
6. What are my chances for advancement with Alcoa?

And Here's What We Answer:

1. There are openings at Alcoa each year for graduates with many types of degrees. Graduates in mechanical, metallurgical, electrical, industrial, chemical and civil engineering have a wide choice of opportunities in engineering, production, research, development or sales engineering. There also are openings for chemists for research and for business administration and liberal arts graduates in accounting and sales.

2. Geographical location will depend on your field. New engineering, production and accounting employees are assigned to one of 30 Alcoa operating locations throughout the nation. New sales engineering and sales administration employees, after completing a six-month training program, go to one of Alcoa's 72 sales offices. If your field is sales development or process development, you will be located in New Kensington, Pa., or Cleveland, Ohio. Main research laboratories are located in New Kensington, with branches in Cleveland, East St. Louis, Ill., Massena, N. Y., and Chicago.

3. Alcoa has a training program for each new employee. Engineering and production training involves orientation and rotation of assignments for approximately one year. Sales training is conducted in sales offices and in nine plant locations over a six-month period. Accounting training calls for rotation of assignments for 18 to 24 months.

4. Alcoa's starting salaries are competitive with those of other companies. An initial salary is established for a basic four-year degree. Additional credit is given for outstanding personal qualifications, advanced educational training, military service and previous work experience. Future salary progress is based on your own performance and growth potential.

5. Alcoa pays transportation and moving expenses for you and your family. This applies to your first and all subsequent assignments.

6. Alcoa personnel policies assure individual recognition for you. They include regular performance appraisals, individual opportunity for advanced management training, confidential and individual salary consideration and promotion entirely from within the company.

If you'd like to find out more about employment opportunities with Alcoa, contact your placement officer to arrange a campus interview. Mutual interest will result in further interviews at an Alcoa location. For more details immediately, write Manager, College Recruitment, 810 Alcoa Building, Pittsburgh 19, Pa., for the new booklet, *A Career for You With Alcoa.*

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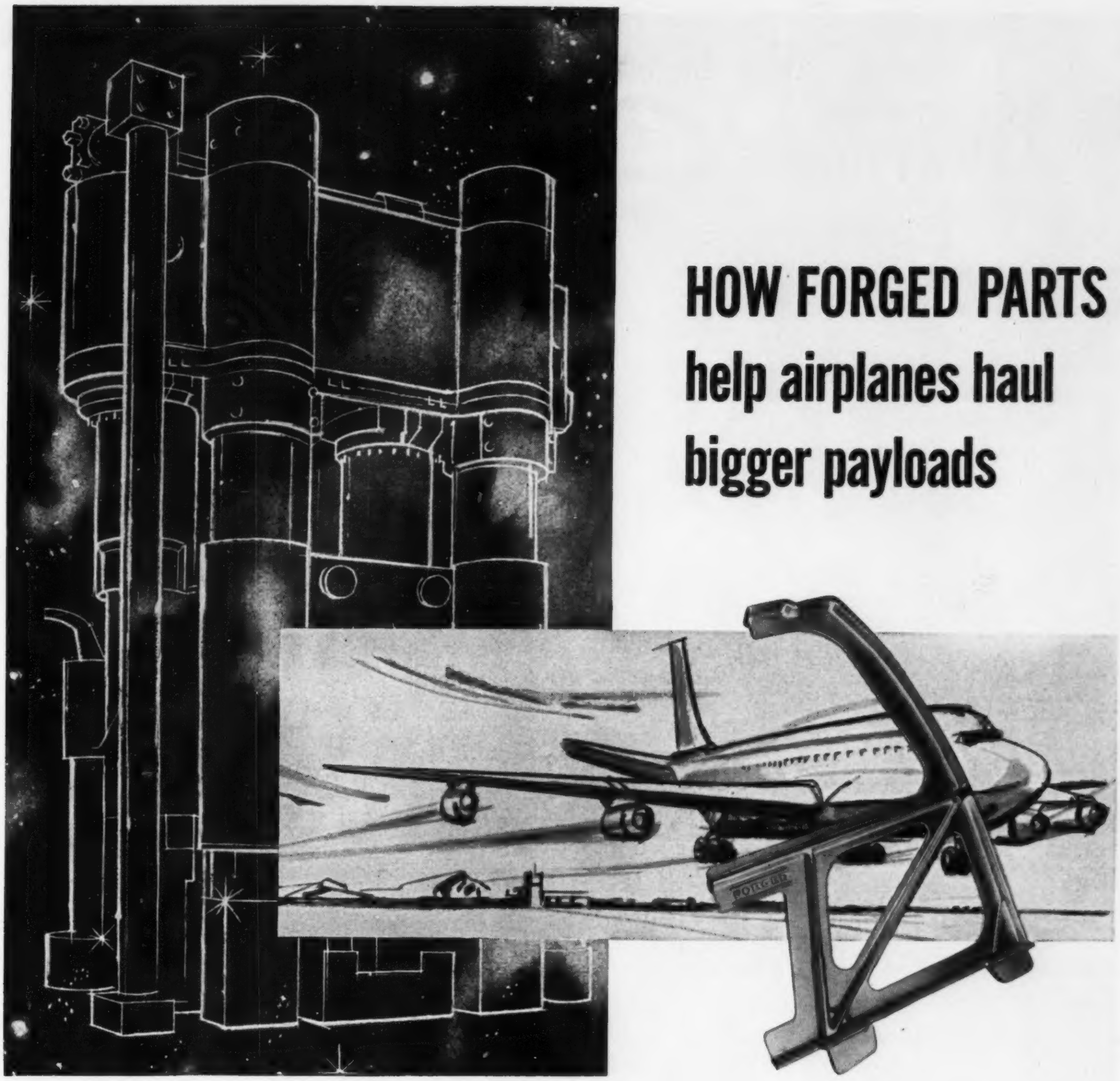

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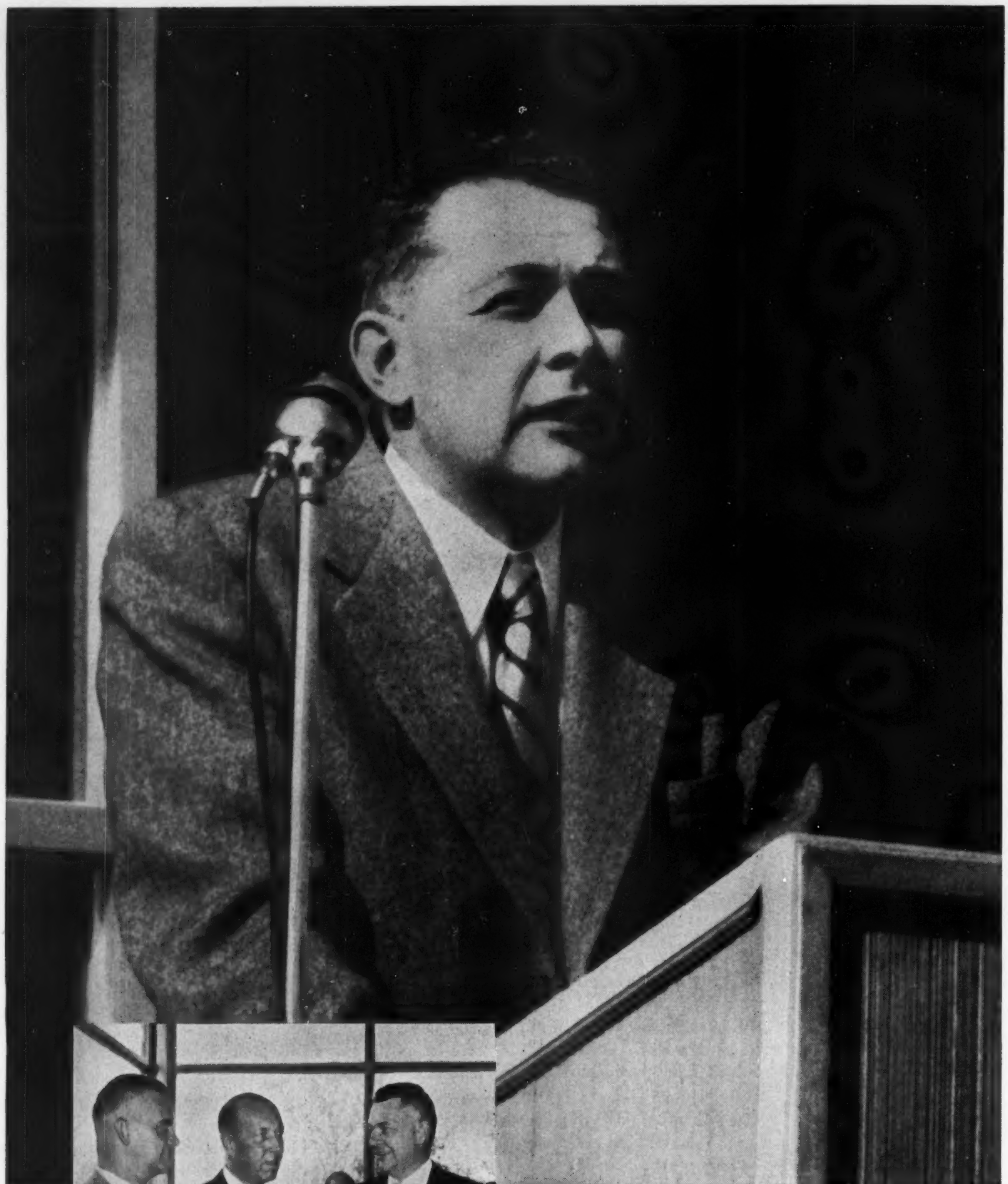

Could this be a picture of you tomorrow? In the fall of 1958, it was Jack Carroll, principal speaker at the opening of Electronic Associates' modern new plant in Long Branch, N. J.

Jack Carroll (*right*) discusses the new equipment he has just seen during a visit with Henri Busignies, President of ITT Laboratories (*center*) and Anthony Pregliese, ITT Public Relations.

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FIFTY YEARS AGO IN THE ENGINEER

Edited by J. F. Shapiro, ME '61

One who thinks that the driving of a nail simply consists in getting the whole length of it out of sight has little conception of the real nature of the operation. A nail driven by an expert will often hold several times as much as one ill driven; while, too, it is often made to draw the parts into place. If you have ever watched a mechanic driving nails, you have doubtless noted that he rarely drives one at right angles with the face of the work. There is a reason for this. Suppose that he is nailing the "sheeting" on the frame of a building, and desires to draw the board down tightly against the one below it; he points the nail downward, and a few well-considered blows at last produce the desired effect. If the board is bent edgewise, so that much force is required, probably he will start the nail in the upper edge, pointing very sharply downward. Again, two nails driven in a board at different angles will hold it in place much more firmly than the same nails would if they were driven in at right angles with the face of the board. *The Sibley Journal*—November, 1909.

The latest Santos Dumont airship is the smallest one in existence. "La Demoiselle" is his twentieth machine and is also the fastest aerial craft built. It made 96 kilometers an hour on its run from Saint Cyr to Rambouillet on September 18th. Arrangements have already been made with Clement and Charron for the manufacture of one thousand of these machines. *The Sibley Journal*—November, 1909.

In a newspaper article by the President of Yale University, published some time ago in the *New York Times*, a number of interesting facts were brought out concerning general culture. The hue and cry nowadays is "how much will it pay?" and in educational affairs as well as business the training which will repay the student soonest is the one sought after. Hence the technical schools are chosen in preference to those providing a more liberal education. And in this search for practical education, the desirability and utility of the liberal education is overlooked. The very words Greek or Latin are not in the vocabulary of the average business man, nor does he desire them to become acquainted with his son. But by general culture many other subjects beside the dead languages are meant. General culture is after all only broad mindedness. A man with education looks beyond, sees the underlying reasons and necessary results of great movements . . .

A moment's consideration will show that all the qualities attributed to the man of culture are essential to the engineer. They are not needed to better enable him to move in society, to converse with educated people, but in his daily occupation. Nothing is more necessary than the ability to weigh evidence. He may have a thorough knowledge of mechanics or thermodynamics but still the problems he is forced to confront are not purely matters of science, other elements enter. The human factor—the buyer and the seller, or employee and employer, combine to complicate matters. He must make abstracts of all that does not directly pertain to his project and consider all factors that do pertain to it. For example a power house project for a large city, introduces problems of real estate, taxes, insurance, railroading, freight, water rights, smoke liabilities, all combining with the actual problem of developing a certain amount of power from the potential energy of coal . . . The engineer must sift through great amounts of data and facts before he has completed his work. The man who has such work in hand must necessarily be a man of culture. . . . *The Sibley Journal*—November, 1909.

Engineers as a rule have abominably poor memories, being compelled by custom, habit, and ofttimes instruction, to virtual serfdom to handbooks, et al: whereas they should, it would appear, bend every effort to developing a trained faculty of memory and cultivating reliance upon it.

There is no valid reason why an engineer should not remember facts as easily and readily as the politician or schoolmaster names and faces. Ex-President Roosevelt is said to assign much of his success to a marvelous development of this faculty. At any rate, although knowing perhaps a thousand times as many individuals as you or I, he is said never to have failed instantly to recall a face and a name. If the engineer were studiously to make it his business to remember reliably he could duplicate this feat. But, on the contrary, he is ofttimes by instruction, led to believe that the memory is unreliable and that he is not to depend on it. This assertation I refute. I maintain that the memory faculty is dependable, and have had in my own experience many proofs of it. . . . Nothing, how-

ever trivial or momentary, escapes the attentive mind, and is perfectly recorded by a process more exact and permanent than the phonographic record and the camera. It but remains for us to learn how to reverse the process, how to render instantly available the vast stores of knowledge forever treasured in the archives of the mind.... What is the light that reveals all things arrayed in perfect order, for our instant use? It is absolute confidence or faith in the perfectness . . . of our memory faculty. It is fears and doubts, instilled by false or limiting beliefs, that lock the prison door, and bind and shackle the mind of man. The simple rule that I would offer, then, is this:

Focus attention undividedly on the task at hand, carefully and thoroughly and whole-heartedly regard all things, and all things will in the doing be accurately and completely recorded. Then, to use, know with perfect confidence, that the memory is perfect, and it will be found that whatever fact is needed at the instant will spontaneously reveal itself. *The Civil Engineer*—November, 1909

It has long been recognized that among the undergraduates of the college there is a lack of interest in the discussion of current engineering problems. The general spirit among the students seems to be that they are getting enough technical education when they do the assigned work, and any extra time spent on the subject they have chosen as a life profession is heartily begrudged. This is a mistake, and the thinking student readily admits it.

We are going into a field of practical problems which demand of us not only the ability to solve them, but also the ability to convince others that that solution is the best one possible. It is this extra ability of being able to meet men on their own ground and win them over to your way of thinking which often distinguishes the successful man from the unsuccessful, the employer from the employee. A training of this sort is not in the curriculum, but would be greatly encouraged by the students discussing among themselves papers prepared by their fellows. *The Civil Engineer*—October, 1909.

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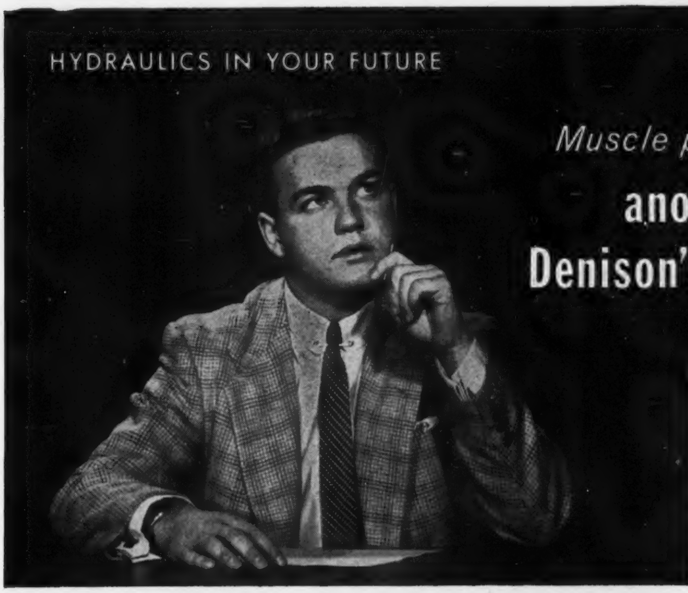

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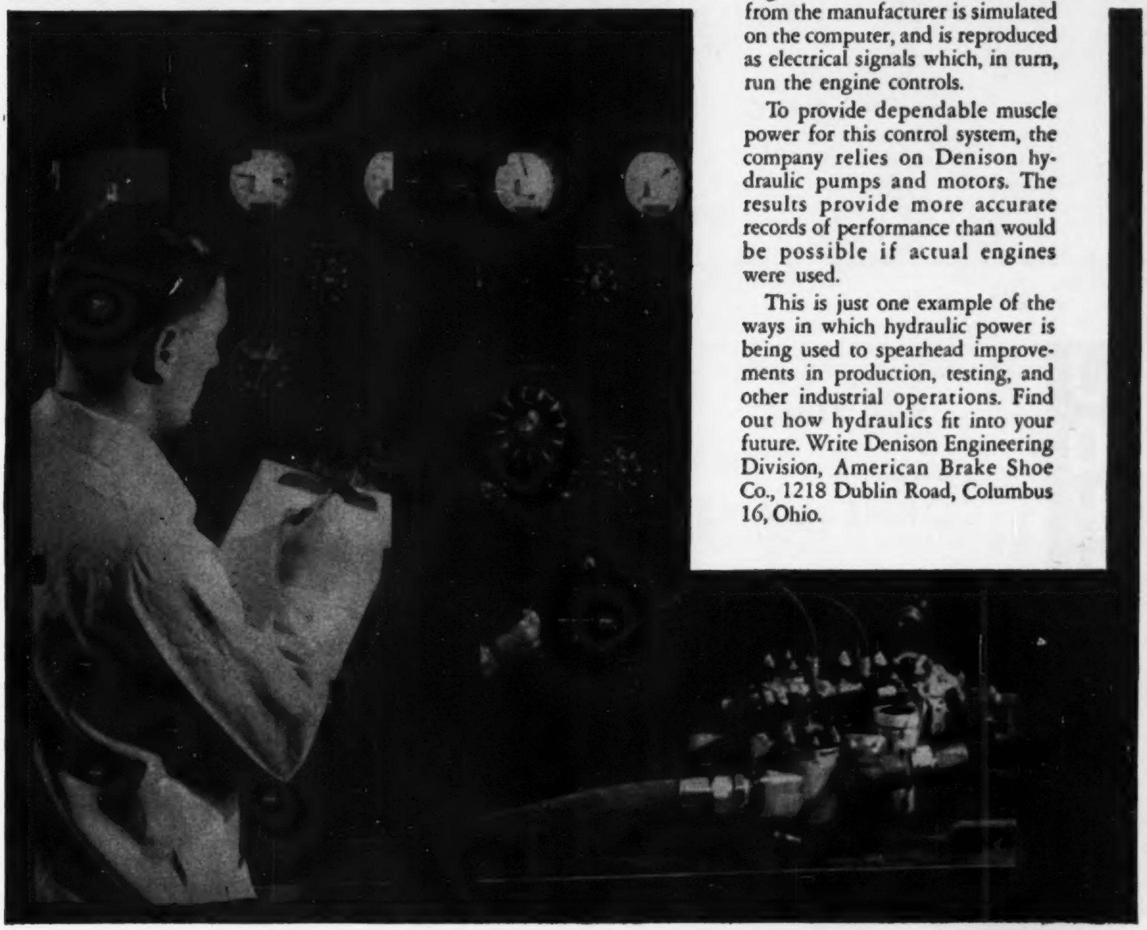

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STRESS *and* STRAIN...

Edited by D. J. Martin, ME '62

An old Indian visited the big city for the first time in his life. He entered a building and watched a little old lady step into a small room.

The doors closed behind her. Lights flashed and a dial above the door moved from one up to ten and back again. A bell tinkled. The doors came open, and a beautiful young girl stepped out of the elevator.

Blinking in amazement, the Indian grunted, "Me should have brung um squaw."

• • •

"Mummy, why is it that Daddy doesn't have much hair?"

"Because he thinks a great deàl, dear–"

"But mommy, why is it that you have so much hair?"

"Finish your breakfast dear."

• • •

Critic: "It strikes me as being an impressive statue, yet isn't that rather an odd posture for a general to assume?"

Sculptor: "It isn't my fault. I had the job half done when the committee decided they couldn't afford a horse for the general."

• • •

A student went over to the infirmary. "Doc," he said, "I feel so bad it makes me want to kill myself."

"Now, now," said the doctor, "you just leave that to us."

• • •

Engineer: "Going around with women a lot keeps you young."

Second Engineer: "How come?"

Engineer: "I started going around with women when I was a freshman two years ago and I'm still a freshman."

• • •

The student had bought a new shirt and had found a slip pinned inside with a girl's name and address and the request: "Please write and send a photograph." Romance stirred in the student's heart. He sent off a letter and a picture of himself. A few days later a letter arrived which he opened with racing heart. It read: "Thanks, I just wondered what kind of goof would wear such a dopey shirt."

• • •

Use Mishmash Shaving Cream—no brush, no lather, no rub-in, no rub-off, no box, no nothing—just blood.

• • •

On operations in the North Atlantic, the officer of the deck of a submarine glanced at the compass repeater on the bridge and noticed that they were off course. "Helmsman, mark your helm–" he shouted down the conning tower hatch.

The reply came back. "One eight zero, sir."

"What the devil are you doing twenty degrees off course?" asked the officer.

Up came the answer from the young seaman on helm duty, "Coming back from thirty, sir."

• • •

"I know a man who has been married for thirty years and he spends every evening at home."

"That's what I call love."

"The doctor calls it paralysis."

• • •

The doctor came out of the room and spoke to the anxious wife.

"Frankly," he said, "I don't like the way your husband looks at all."

"Well," replied the wife, "Neither do I, but he's nice to the kids."

• • •

A young man whose father had been hanged was filling out a college application. After the usual hereditary questions, there was one asking the cause of the death of his parents. He thought awhile and finally put down his answer: "Mother died of pneumonia. Father was taking part in a public ceremony when the platform gave way."

A drunk approached a large hotel in the windy city, Chicago, just as a gust of wind spun the revolving doors. The drunk stepped back, looked up at the tall building, turned to the doorman and said, "He'll never get her off the ground."

• • •

Two Cornell M.E.'s were on their way home for vacation on a very cold day. They were riding a motorcycle, and the fellow in back was freezing so, when they stopped for gas, he took off his coat and put it on backwards, buttoning it up to keep out more wind. Soon after they started off again, they ran smack into a telephone pole.

The policeman who called in about the accident reported the following to the police chief: "The man riding in front was killed instantly. The man who was riding in back was still alive when we got there, but he died when we straightened out his neck.

• • •

Old grandpap Zeke had wandered off into the Ozark woods and hadn't showed up for supper. Young Zed, sent to look for him, finally located the old man standing in some bushes.

"Getting dark," the boy said.

"Yep."

"Ain't ye hungry?"

"Yep."

"Well, ye comin' home?"

"Nope."

"Why ain't ye?"

"Standin' in a b'ar trap."

• • •

Then there's the fellow who bred his parakeet to a tiger. He doesn't know what he's got, but when it talks, he listens.

• • •

The waitress was wondering why the elderly man was eating while his wife was staring out the window.

"Aren't you hungry?" asked the waitress.

"Sure am," was the reply, "I'm just waiting till Paw gets through with the teeth."

One of a series*

Interview with General Electric's
Charles F. Savage
Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies—mature, knowledgeable men—have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR** other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.

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